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Experiments on the Friction and Abrasion of the Surfaces of Solids.

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[From the Transactions of the Royal Society.]

THE paper now offered to the consideration of the Royal Society, comprises the results of part of a series of experiments undertaken in the year 1825, with a view to determine the measure of the retardation of bodies in motion, when affected by the attrition of their surfaces, and by mediums of different densities.

From the attention that has hitherto been paid to this important branch of mechanical science, and from the many elaborate dissertations and experiments that have appeared at different periods, it would naturally be concluded, that the subject had been so fully elucidated, as to admit of little, if any further, investigation: but the diversity of opinions still prevalent among philosophers, and the difficulty of reducing to a satisfactory state the doctrines already advanced, incline me to the opinion that the subject is as yet but imperfectly understood. This may be attributed, in a great degree, to the very defective state of our knowledge of the properties of materials, and the difficulty, or rather impossibility, of subjecting them to geometrical mensuration. The science of mechanics considers forces as reduced to the simple questions of mathematical analysis, without regard to the properties of matter, or the phenomena incident thereto: but in rendering forces sensible, we are necessarily compelled to make use of agents, or intermediate bodies, termed machines, the employment of which in transmitting motion,

in modifying its action, or in restoring the equilibrium between forces of different intensities, constitutes the object of every mechanical operation. The solution of this question, therefore, involves the conditions of equilibrium, both of simple and compound machines; the transmission of motion under different circumstances; the construction and combination of the different parts of machines, and the properties of the materials of which these parts are composed.

On a former occasion an attempt was made to develop some of the properties of solid bodies in resisting the action of a disruptive force,* the measure of which was represented by the sum and qualities of the particles displaced. The connexion may be traced, in the present inquiry, which relates principally to the resistance arising from the displacement, or rupture, of the superficial asperities of bodies in motion when brought into contact by extreme pressure, and is analogous to the cohesive state of a body acted upon by opposite, but contrary forces. But the cases investigated by experimentalists have seldom been carried to the extent necessary to produce a disrupture of the prominencies, being generally confined to the definition of friction as designated by writers on mechanics, to be the force expended in raising continually the surface of pressure by an oblique action; the surfaces being represented by a series of inclined planes acting against each other in alternate succession. The measure of friction, therefore, being supposed to depend upon the angles of the prominencies and the elementary structure of the bodies, the effect of polishing could only be to diminish those prominencies without altering their curvature or inflections. The expense of force, therefore, ought still to remain the same in both cases.† In this hypothesis it is reasonable to concur, experiment proving, that the amount of friction bears immediate reference to the elementary structure of bodies; and although the doctrine of inclined planes admits of a ready comprehension of the causes of this kind of resistance under certain circumstances, a very slight investigation of the nature of the bodies themselves will exhibit their asperities under every possible configuration. The amount of resistance will depend upon the degree of pressure, the approximation, or rather the engagement of the asperities and concavities, and the nature of the surfaces of which fibrous, soft, or hard bodies, are composed. To surmount, bend, or detach these asperities, under the circumstances of pressure, area, and velocity, demands a proportionable exertion of force; and it is by the determination of this force under all cases, that we can alone arrive at an estimation of the performance of machines.

The nature of friction has excited the attention of most of the writers on mechanics, from the period of the first two dissertations of Amontons, in the year 1699, down to the more elaborate researches of Coulomb and Vince, in 1779 and 1784. Amontons was the first that attempted to develop and reduce theory to calculation. He

* Experiments on the Strength of Materials:—Philosophical Transactions, 1817.

† Leslie's Experimental Philosophy.

affirmed that friction was not augmented by an increase of surface, but only by an increase of pressure;* and in a subsequent paper, illustrated by some experiments on wood and metals pressed by springs of known intensity, he drew similar conclusions, with the addition that friction was one-third of the pressure, and that the amount was the same both with wood and metals when unguents were interposed. He likewise concluded, that friction increased or diminished with the velocity, and varied in the ratio of the weight and pressure of the rubbing parts, and the times and velocities of their motions. These hypotheses were adopted more or less by most of the philosophers after Amontons, but particularly by De la Hire,† who satisfied himself by several experiments, of the truth of Amontons' conclusions; but they were questioned by Lambert, although without the test of experiment. Parent suggested an investigation of the subject in his proposition of the spheres, and by determining the angle of equilibrium, at which a body resting on an inclined plane commenced sliding. And the celebrated Euler, in a very elaborate paper,‡ conceived it to depend upon the greater or less approximation of the asperities of the surfaces brought into contact by pressure, the resistance to which he allows to be one-third of the pressure; the same as Amontons. Of the effect of velocities, he was, however, uncertain; but observed that when a body begins to descend an inclined plane, the friction of the body will be to its weight or pressure upon the plane, as the sine of the plane's elevation to its cosine, &c. But when the body is in motion, the friction is diminished one-half. Muschenbroek and others maintained that friction increased with the surface; and Bossut distinguished it into two kinds: the first being generated by the gliding, and the second by the rolling of the surface of a body over another: and remarked, that it was effected by time, but that it neither followed the ratio of the pressure nor the mass. Brisson§ attempted to construct a table of coefficients, to denote the value of the friction of different substances; but they are inapplicable to practical purposes, for want of proper experiments. Desaguliers considered the nature of friction with a good deal of attention, but principally with reference to the rigidity of cords. He, however, quotes the experiments of Camus as best calculated to illustrate the subject; nevertheless, they were made on too small a scale to derive any satisfactory conclusions. Schober and Meister coincided with Muschenbroek in the opinion, that the spaces were as the squares of the times in the case of a body uniformly accelerated. The opinions of many other eminent philosophers, such as Leibnitz, Varignon, Leupold, Bulfinger, Daniel Bernoulli, Ferguson, Rondelet, Gregory, Leslie, Young, Olivier,‖ &c. might be quoted. But it is to Coulomb principally that we are indebted for the knowledge we possess of this kind of resistance.

* Sur la Force des Hommes et des Chevaux, et de la Resistance causé dans les Machines.

† Mémoires de l'Academie des Sciences. ‡ Ibid.

§ Brisson, Traité de Physique.

‖ Sur les diverses Espèces de Frottements, &c. (not published.)

In the year 1779 the Academy of Sciences at Paris, being desirous of rendering the laws of friction, and the effects resulting from the rigidity of cords, applicable to machines,—Coulomb undertook, in the arsenal at Rochfort, a very extensive series of experiments, which he afterwards published in 1781 under the title of "Théorié des Machines simples, en ayant égard au Frottement de leurs Parties, et á la Roideur des Cordages."* The memoir is divided into two parts. The first treats of the friction of surfaces gliding over each other, and the second enters into an examination of the rigidity of cords, and the friction of the rotary movements of axles. Coulomb commences his work by examining the friction of plane surfaces gliding over each other, distinguishing it into two kinds; the first resulting from time, and the second from velocity. The first may depend on four different causes, viz.

1st. The nature of the bodies in contact.

2nd. The extent of surface.

3d. The pressure on the surface.

4th. The time the surfaces have been in contact. And he even adds a

5th. The state of the atmosphere; which he, however, thinks may have little influence.

The case of bodies gliding over each other with a certain velocity, he considered to be referrible to the first three causes, besides the velocity of the planes in contact.

With regard to the physical cause of friction, he coincides with the opinions of Amontons and others, that it arises from the entangling of the asperities, which can only be disengaged by bending or breaking. These experiments led to some important results, viz.

1st. That the friction of wood on wood without unguents, was in proportion to the pressure which attained its maximum in a few minutes after repose.

2nd. That the effects of velocities were similar; but the intensities were much less to keep the body in motion, than to detach it from a state of rest, oftentimes in the ratio of 22 : 95.

3d. That in the case of the metals the results were likewise similar; but the intensity was the same, whether to disturb or maintain the motion of the body.

4th. That with heterogeneous surfaces, such as those of woods and metals gliding over each, the intensity did not attain its limit sometimes for days.

In general, however, with woods and metals without unguents, velocities were found to have very little influence in augmenting friction, except under peculiar circumstances.

The treatise of Coulomb is illustrated by a great variety of interesting experiments, and forms the most valuable work we possess on the subject.

In the year 1784, Dr. Vince endeavoured by some very ingenious experiments, to determine the law of retardation, together with the

* Memoires des Savans Etrangers, tome 163 and 333.

quantity, and the effect of surface on friction. The results were, that the friction of hard bodies in motion was a uniformly retarding force, but not so with cloth and woollen, which were found in all cases to produce an increase of retardation with an increase of velocity.

That the quantity of friction amounted to about one-fourth of the pressure, and that it increased in a less ratio than the quantity of matter or weight of the body.

That when the surfaces varied from 1.61 : 1 to 10.06 : 1, the smallest surface gave the least friction: and, finally, that friction was greatly influenced by cohesion.

Dr. Vince's conclusions regarding the laws of retardation were partly confirmed by the late ingenious Mr. Southern, of Soho, who, in a letter to Dr. Vince in 1801, communicated the results of several experiments on the surfaces of the spindles of grindstones moving with great velocities; when it was found that with the rubbing surfaces moving at the rate of 4 feet per second over a length of surface of 1000 feet, the resistance arising from the friction of 3700 lbs. of matter, only amounted to one-fortieth of the weight.

In the year 1786, and subsequently, the late Mr. Rennie made several experiments on the friction and resistance of heavy machinery. The results varied under different circumstances; but it appeared that an augmentation of resistance took place in proportion to the quantity of machinery put into action. In one instance, in the ratio of 1 to 5, when it absorbed from one-fifth to one-tenth of the power expended.

This anomaly, as compared with the ratio of surfaces in the present experiments, can only be accounted for, from the irregularity of the movements and the difficulty of producing simultaneous actions in complicated machinery; the more especially as the results were affected by contingencies which could not be properly estimated; some of the elements on which the deduction is founded not being stated. The resistance was, likewise, increased, by reversing the direction of motion. The velocities being very moderate, and hardly exceeding 120 feet a minute, appeared to have had no influence: but the experiments related principally to the resistances produced by different kinds of machinery. The experiments of M. Boistard* on the gliding of stones, with a view to develop the equilibrium of arches, led him to conclude that the relation of the friction to the pressure was constant; that asperity of surface did not alter its value, which generally amounted to four-fifths of the pressure.

From similar experiments M. Rondelet concluded,†

1st. That the rougher the surface of stones, the greater the power required to move them.

2nd. That the greater the insistent weight, the greater the resistance: but as the inequalities are apt to be broken, the maximum

* Recueil d'Experiences et d'Observations, &c. sur le Pont de Nemours.

† L'Art de Batir, tome iii. 1808.

force required to overcome the friction, ought to be equal to produce that effect, whatever be the weight of the stone.

3d. That this force ought rather to be in the ratio of the hardness of the stone than of its weight.

4th. The amount of friction varied from one-half to one-third of the insistent weight.

5th. The angle of equilibrium of similar stones was about 30 degrees. And,

6th. Finally, extent of surface did not alter its value.

The experiments of Morisot on the grinding and polishing of stones, and of Maniel and Pasley on the pressure and equilibrium of earths, present some interesting results; but it is only recently that our knowledge of the subject has been materially enlarged.

The agitation of the canal and rail-road question in the years 1824 and 1825, and the invention, or rather revival, of a mode of applying steam in lieu of animals to carriages on rail-roads, led to the most extravagant conclusions: and although the doctrines of Coulomb and Vince, relative to the equality of resistances under different velocities, have been still further confirmed by the experiments of many able persons in this country, such as Chapman, Grimshaw, Wood, Tredgold, Palmer, Roberts, and others, and much valuable information elicited;—our progress in the science has been but slow and unsatisfactory. Sensible of these defects, and being unable to profit by the valuable treatises subsequently published, it occurred to me that a series of experiments founded on the omissions of former writers would be extremely desirable.

The present series of experiments relates to the friction of attrition. This branch of the science comprehends the resistance occasioned by solid bodies,—such as ice, cloth, paper, leather, wood, stones, metals, &c. gliding over each other simply, or by the intervention of semi-fluids or unguents, such as oil, tallow, &c.

The object has, likewise, been to determine the powers to resist abrasion under the circumstances of surface, pressure, and velocity. Examples have been sought,

1st. From ice, by the resistance of its surface to sledges, skates, &c.

2nd. From cloth, by its remarkable properties of resistance in opposition to the law observed by solids.

3d. From leather, by its great utility in the pistons of pumps, &c.

4th. From wood, in its application to pile driving, carpentry, launching of ships, &c.

5th. From stones, as relating to the equilibrium of arches and buildings. And,

6th. From metals, from their universal application to machinery; but more particularly to wheel carriages and rail and other roads, on which a great many experiments have been made.

Experiments on a great scale, however, frequently involve so many contradictions, from the difficulty of obtaining the necessary elements, that I have deemed it preferable to offer the present series,

as comprehending in a greater degree most of the cases in question, and affording a more systematic view of the nature of the investigation.

[TO BE CONTINUED.]

On the Manufacture of French Articles of Perfumery.

[From the *Dictionnaire Technologique*, translated for the Technological Repository.]

THE art of the perfumer is derived, according to some historians, from the most remote periods. Diodorus of Sicily pretends, that the Egyptian priests were the only possessors of the necessary recipes for embalming dead bodies.

The number of these articles of perfumery is now-a-days become very considerable.

The business of the perfumer consists in the preparation of the various products which we shall hereafter mention, and which are divided into two classes: namely, the perfumes from Grasse, and those of Paris. The first and most important branch comprehends the fabrication of the prime materials, and which should be done in the localities where they are produced; and the second also merits attention, from the immense consumption of articles in perfumery.

THE PERFUMES FROM GRASSE, IN THE DEPARTMENT OF VAR.

Preparation of the fats of the pommades by infusion, and of those made without infusion; on oils; on distillation; and on the extraction of essential oils or essences.—Grasse, from the mildness of its climate, is one of the finest towns in Provence, the natural soil of the aromatic plants. Numerous and various kinds of flowers grow in such abundance there, as to require but little care in their culture. Amongst those ordinarily grown at Grasse, we may enumerate the following: the jasmine, the rose, the violet, the tube-rose, and the jonquille. It is to be regretted that, amongst the number, we cannot also find the orange, the citron, the hyacinth, the mignonette, the heliotrope, which would double the revenues of the proprietors; but we suppose that there exist causes which oppose their vegetation. Not two leagues from thence, in the small village of Canet, they collect various kinds of flowers, of which the annual product cannot be less, on a moderate estimation, than two hundred thousand francs!

Before describing the processes employed in the fabrication of the perfumeries of Grasse, we must give an idea of the mode of preparing the fatty materials. These take the precedence before all others; as from them are prepared a great part of the perfumeries of Grasse, as well as those of Paris.

The perfumer employs in the whole three kinds of fat: namely, that of pork, beef, and mutton. The modes of preparing them differ but little from those in common use; but it is necessary, nevertheless, to make known the changes and improvements which the perfumers have latterly made in their manipulations; and which relate only to the fats of pork and mutton. The first is pounded and beaten

in an iron mortar, after having previously cut it small with a hatchet or cleaver; and the second must be carefully freed from all the fleshy parts before subjecting it to the action of heat.

When thus prepared, the fats are pure, and of a perfect whiteness; but care must be taken that the time employed in preparing them be not too much prolonged, lest they might begin to putrify. This quick alteration may also be owing to their retaining some portion of water (an inconvenience difficult to avoid, as in evaporating them sufficiently to drive off the last portions of water, they risk the decomposition of part of the fatty matter also.) The perfumers have, for several years past, adopted the following process, which appears preferable. They pound the fats without the addition of any water, until all the membranaceous parts are completely separated; they then throw this prepared mass into a boiler, heated by a *balneum-marie*, or water-bath. The fat being perfectly melted, the albumen in the blood coagulates, and entangles all the other foreign or extraneous matters; the scum which forms must be carefully removed, and the whole remainder be afterwards passed through a canvass strainer.

ON THE POMMADES MADE BY INFUSION.

Rose, orange-flowers, and cassia.—They take 334 pounds of prepared hog's lard, and 166 of beef suet. (The third part of beef suet which is here added, is intended to give more consistence to the pommade, and especially when it is to be exported to warm climates.) These 500 pounds of prepared fat are to be put into a vessel, termed a *bugadier;* they then add 150 pounds of rose leaves, which they throw upon the melted fat, and carefully stir them for several hours. This infusion, thus prepared, must remain at rest for twenty-four hours; at the end of this time, the pommade is again melted, and continually stirred, in order that none of the rose leaves may adhere to the bottom of the vessel; when melted, it is strained through canvass, in which operation the *marc*, or dregs, take the form of rectangular loaves; these loaves are placed under a press, in order to extract all the remains of the fat from the solid parts. The loaves are held in a barrel, pierced full of holes, and bound with iron, so that the pommade may escape on all sides, and fall into a copper vessel placed under the gutter or spout to receive it.

This operation is repeated many times, in order to avoid the loss which results from the small quantity of pommade which the canvass ordinarily retains. This work, simple as it appears, nevertheless demands great care; and the workman who executes it, can only acquire by practice a perfect knowledge of it.

This process is repeated, with the same fat, ten or twelve times; and thus they employ 3000 pounds of rose leaves to make a good pommade.

The orange-flower pommade is made in the same manner, but it requires still greater care to be taken in pressing it, in order to make it clear, as it is liable to form a deposit.

In preparing the orange-flowers, they remove the yellow parts of

them, when they intend to produce a white pommade; but, unfortunately, their high price prevents them from often practising this method. The pommade, thus prepared, costs at least thirty francs the pound; but it is incomparable as a perfume.

We shall not enter into the details relative to the preparation of the *pommade of Cassia*, as it is made in the same manner as the two preceding ones.

ON THE POMMADES MADE WITHOUT INFUSION.

Jasmine, tube-rose, jonquille, narcissus, and violet.—We take a double dish, termed a *tiame*, and pour into it twelve ounces of the prepared fats of pork and beef, the flowers being contained in the other part; next day these are removed, and replaced by fresh flowers; this process is continued for two or three months, or until the pommade has attained the degree of perfume designed to be given to it. This work requires great care and patience, as the jasmine flowers contain other matters prejudicial to the required scent, which require them to be removed every day; and without taking this precaution, the pommade would become defective.

Some perfumers, nevertheless, employ fusion for making this kind of pommade; but we think it ought to be discontinued entirely, as it cannot but injure this delicate pommade. Lately, M. Thias, of Grasse, has contrived to substitute for the *tiames*, frames composed of four pieces of wood perfectly united, into which he puts a glass vessel, containing the pommade, spread over it with a palette-knife. This is an advantageous improvement, as the room which the *tiames* occupied was considerable, and their great weight was also an obstacle to their superposition. Now these frames can replace them, and the perfumers require four thousand of them for their establishments. The frames are placed one above the other, and a cover is placed over the uppermost one, to hinder the access of the external air. This work is sufficiently curious to attract the attention of travellers, who find a pleasure in visiting the laboratories of the principal manufacturing houses of Grasse.

ON PERFUMED OILS.

The oils of roses, orange-flowers, and cassia.—These are made by infusion, like the pommades of the same odours; and it is an indispensable precaution, that we choose oils which are perfectly fresh; for those of *jasmine, tube-rose, jonquille, and violet*, and, in general, of all delicate flowers, the following is the process:—

They place, on an iron frame, a cotton cloth, imbibed with olive oil of the first quality, and which they completely cover with the flowers. This layer must be but of little thickness. They continue this process, changing the flowers until the oil is saturated with the odour which they desire to communicate to it; at the end of this time, which we can easily conceive must be variable, they submit the cloths to the action of a press. This last part of the process usually occupies eight entire days.

ON DISTILLATION.

The essential oils or essences obtained in the south of France, are those of *roses, neroli, petit-grain, lavender, wild-thyme, thyme, and rosemary.*

These essences are distilled in the usual manner. They obtain, by putting into the body of the still forty pounds of rose leaves, and thirty pints (French) of water, and proceeding to distillation, fifteen pints of rose water. They then continue the operation until they have thus obtained 200 pints of water, termed No. 1. In this first distillation, they obtain an almost imperceptible quantity of the *essence of roses;* but in the second it becomes more apparent; and, finally, in the fifth it becomes notable.

The house of Langier, senior and junior, annually make 250 ounces of essence of roses.

In the distillation of *orange-flowers*, they also obtain the *essence of neroli*, now become of remarkable importance. If they would obtain this essence, they follow the ordinary process, and repass the waters of the first distillations upon new flowers. On the contrary, when it is intended to prepare orange-flower water of a good quality, they draw off a fifth part only of the water placed in the cucurbit.

The essence de petit-grain is obtained by distilling the leaves of the orange-tree; the quantity of essence they afford depends upon their freshness. With respect to those of lavender, wild-thyme, thyme, and rosemary, they present no peculiarities in their extraction.

ON SPIRITUOUS ESSENCES.

Rose, orange, jasmine, tube-rose, cassia, violet, and other flowers. —They take three water-baths, furnished with covers, and put into one of them twenty-five pounds of one of the perfumed oils above-mentioned, and twenty-five litres of spirit, marking three-sixths; they stir the whole every three-quarters of an hour during three days; at the end of this time they decant the spirit thus perfumed, and pour it anew into the second water-bath; they again repeat the same operation in the third bath, and the spirit then obtained is perfected. By continuing the process with the same oil, they likewise obtain inferior qualities, and which they indicate under the terms, No. 2, 3, and 4.

Some perfumers pretend that they dispense advantageously with these oils, by employing pommades strongly impregnated with odours; we cannot say to which of the two the preference ought to be given, as they obtain by both processes similar results.

Scented Spirits.

7 *litres** spirit of jasmine, third operation.
7 *litres* spirit of cassia, third do.
3 *litres* spirit of three-sixths.
2 *litres* spirit of tube-rose, third operation.
1½ ounces of essence of cloves.

* The *litre* is nearly two and one-eighth English wine pints.

½ an ounce of fine neroli.
1½ ounce of essence of bergamotte.
8 ounces of musk, second infusion.
3 *litres* of rose water.

Italian spirit of flowers.

2 *litres* spirit of jasmine, second operation.
2 *litres* spirit of roses, second operation.
2 *litres* spirit of oranges, third operation.
2 *litres* spirit of cassia, second operation.
1½ *litres* of orange-flower water.

Spirit of Cytherea.

1 *litre* of spirit of violets.*
1 *litre* of spirit of jasmine, second operation.
1 *litre* of spirit of tube-rose, second operation.
1 *litre* of spirit of pinks.
1 *litre* of spirit of roses, second operation.
1 *litre* of spirit of Portugal.
2 *litres* of orange-flower water.

PERFUMERIES OF PARIS.

Of Pommades.—We can reckon twenty odours for pommades; from flowers and from compounds. This last kind of pommades is an imitation of those flowers which are not cultivated in France. The essences usually employed in making of pommades are those of *bergamotte*, citron, *cedrat*, *limette*, Portugal, rosemary, thyme, wild-thyme, lavender, marjorum, and cinnamon.

We divide these pommades into three qualities:—

Fine pommade.
Superfine pommade.
Roman pommade.

As these last require particular care, we shall give the preparation of the Roman *pommade à la Vanille.*

12 pounds pommade of roses.
12 pounds oil of roses.
1 pound *Vanille*, first quality, pulverized.
6 ounces of *bergamotte.*

The pommade must be melted in a water-bath; the vanille is then to be thrown in, and stirred continually for an hour; it is then left at rest for two hours; this time is sufficient for the vanille to be completely deposited; the clear part is then to be drawn off, and the pommade thus formed will be of a yellow colour, which is much preferable to that of the ordinary brown colour.

We must here make an observation relative to the odorous extracts and waters. We should always employ in preference the spirits of flowers; which ought to be prepared by first macerating the flowers in the alcohol, and then adding the different essences

* These spirits usually mark 28° of the *alcometre.*

necessary to give the perfume the required odour. Unfortunately, they often neglect to perform this necessary operation. These spirits of flowers ought always to form the bases of good perfumes.

ODOROUS EXTRACTS.

The alcohometric degree of the spirit employed for these, however variable, should always exceed 28 degrees.

Extrait de Bouquet.

2 *litres* spirit of jasmine, first operation.
2 *litres* extract of violets.
1 *litre* spirit of cassia, first operation.
1 *litre* spirit of roses, first operation.
1 *litre* spirit of oranges, first operation.
1 *litre* extract of pinks.
4 *gros* of benzoin.
8 ounces of essence of amber, first infusion.

Extract of Peach Blossoms.

6 *litres* of spirit, at three-sixths.
6 pounds bitter almonds.
2 *litres* spirit of orange-flowers, second operation.
4 *gros essence de laurier amande.*
4 *gros* balsam of Peru.
4 ounces essence of citron.

COLOGNE WATER.

There are two processes which are equally employed in the preparation of *cologne water;* namely, distillation and infusion.

The first is now generally abandoned; but it is, nevertheless, beyond contradiction, the preferable one.

The only essences which are employed, and which have given to this water its great celebrity, are the following: *bergamotte*, citron, lavender, rosemary, Portugal, and *neroli*. All these should be of the first quality; but their proportions may be varied according to the choice of the consumers.

The lavender waters are now indeed but little esteemed; nevertheless, for their virtues, they are in daily use; they ought always to be prepared from the fresh flowers, and not by a solution of the essence of lavender in alcohol.

ODOROUS WATERS OF LAVENDER, HONEY, VULNERARY, AND ARQUEBUSADE.

We can reckon, in articles of perfumery, thirty different odours; these are varied according to the choice and skill of the manufacturer. We shall content ourselves with giving the recipes for the three following ones. Amongst these will be found the *English honey-water*, which we now manufacture with great success.

Honey-water.

6 *litres* of spirit of roses, third operation.
3 *litres* of spirit of jasmine.
3 *litres* of natural spirit, of three-sixths.
3 ounces of essence of Portugal.
4 *gros* flowers of benzoin.
12 ounces essence of vanille, third infusion.
12 ounces essence of musk, third infusion.
3 *litres* of orange-flower water, of a good quality.

Eau de Mille Fleurs.

18 *litres* of spirit of three-sixths.
4 ounces of balsam of Peru.
8 ounces of essence of *bergamotte.*
4 ounces of essence of cloves.
1 ounce of essence of ordinary neroli.
1 ounce of essence of thyme.
8 ounces of essence of musk, third infusion.
4½ *litres* orange-flower water.

Eau de Mousseline.

2 *litres* spirit of roses, third operation.
2 *litres* spirit of jasmine, fourth operation.
1 *litre* spirit of pinks.
2 *litres* spirit of orange-flowers, fourth operation.
2 ounces essence of vanille, third infusion.
2 ounces essence of musk, third infusion.
4 *gros* essence of sandal-wood.
1 *litre* orange-flower water.

All these three waters should mark twenty-four degrees. As they possess similar properties, they require no further remark.

Lately, MM. Langier have invented two new waters; one of these is named *eau de Langier*, and the other *eau anti-pestilentielle.* This last is principally intended to remove the disagreeable odours which are produced whenever the chlorates are made use of.

Dentifrice Waters.

We shall indicate those of these waters which are most known.

Eaux de Grenouch, balsamique, dentifrice et rose ètherée.—Some persons prefer to use powders; but they are always hurtful, on account of the cream of tartar which they contain.

Etherial Balsamic Water.

5 *litres* of spirit of three-sixths.
2 *gros* of spirit of mint.
2 *gros* spirit of neroli, best quality.
2 *gros* spirit of cinnamon.
2 *gros* spirit of amber.
1 *gros* of sulphuric ether.

Put them into a matras, and infuse them in a water-bath for eight days.

Balsamic Water.

18 *litres* of spirit of three-sixths.
1½ *litres* of spirit of cochlearia.
1½ *litres* of spirit vulnerary.
9 pounds of cloves.
12 pounds of the roots of *pirette.*
12 pounds of fine cinnamon.
3 pounds of starry anise-seeds.
2 *gros* of saffron.
4 *gros* of fine spirit of mint.

ESSENCES FOR REMOVING SPOTS.

There are two essences equally employed for this purpose; the one is termed *essence de citron,* and the other *essence nouvelle à détacher;* both of the two have the advantage of not leaving any unpleasant odour.

Essence à Détacher, Parfumée.

3 *litres* of spirit of three-sixths.
1 pound of white soap.
1 pound of ox-gall.
1 ounce of essence of citron.
2 ounces of essence of mint.

ALMOND PASTE.

These are divided into three kinds, but are all prepared nearly in a similar way; namely, brown almond paste, white sweet almond paste, and white bitter almond paste.

The first is made of the kernels taken out of apricot stones, as also with almonds; these are formed into loaves, weighing five or six pounds each, and are then subjected to pressure, in order to extract the oil (300 pounds of almonds will yield about 130 of oil.) The press is turned or squeezed closer every two hours, during three days; at the end of this time the loaves are withdrawn from the press, when they are dried, in order to be pounded; and, lastly, are passed through a sieve.

The second kind is obtained by scalding the sweet almonds in boiling water, until their skins become completely detached; they are then put into a basket and cooled, and the skins entirely separated; when they are become dry, they are subjected to the same processes as the preceding.

The third kind is prepared as the second is, only that bitter almonds are made use of.

[TO BE CONTINUED.]

On the Preparation of German Silver, Packfond, Argenton, or Electrum: a new Metallic Alloy.

[From the *Dictionnaire Technologique*, translated for the Technological Repository.]

This is a new alloy, known by these different names; and is composed of copper, nickel and zinc; and which imitates silver sufficiently well, owing to its whiteness, its hardness, and its unalterability.

To manufacture this alloy, which now begins to be much used in Germany, it is necessary to commence, by purifying the *speiss*, or *kupfernickel;* an ore which contains, besides nickel, a little cobalt, copper, iron, and much arsenic; and from which it is essential to free it. The Germans have not made known by what means they refine it; but it is probable, that by the aid of roasting, and repeated fusions, they free it from the arsenic. This, however, is certain, that we receive what is termed the *pure nickel*, from Germany, in two different states; namely, in small grains, well fused, and in the form of a coarse black sponge, which has no metallic lustre: they state that neither of these contain any arsenic; nevertheless, they do contain a small portion of it; and in order to employ this alloy with advantage, it would be useful to search for a more exact method of purifying it.

The following are the processes employed in Germany to make *packfond*, as described by MM. Robert and Co. This alloy is formed in various proportions; and it is harder, and less liable to alteration, the more nickel it contains. Thus, for example, we may employ one part of nickel, two and three-quarters parts of copper, and three-quarters of a part of zinc. This last alloy is more difficult to work, on account of its hardness; but as it is less liable to alteration, so we should give it the preference for various utensils for culinary purposes, as well as for the laboratory.

We must also observe, that the *packfond* is the better, accordingly as the zinc and copper, which enter into its composition, are the more pure; and they affirm, that the presence of a little lead in the zinc, greatly diminishes the malleability of the alloy.

Supposing, then, that we are furnished with all the materials properly prepared, and have at command a wind-furnace with good bellows; we commence with pulverizing the spongy nickel, to which we add the necessary proportion of zinc, and place the mixture in a crucible, covering it with the requisite quantity of copper. When the crucible has been thus charged, and well covered, it must be placed in the furnace, upon a foot of baked clay, resting upon the grate of the furnace; the whole must be covered with charcoal, and exposed to the action of the fire. As the spongy nickel also contains some vitreous portions, and we must remove the scorias which float upon the surface; so, when the whole has entered into complete fusion, we must stir the alloy well with an iron rod, and which will also conduce to render the composition uniform in all its parts; we must then pour it into iron moulds, well polished inside, and which

will form it into ingots, of about an inch thick. In order that these ingots may be conveniently laminated, we may make them about nine lines thick, nine inches long, and four wide.

However well the process may have been performed, yet we shall find at the summit of the ingot, a depression, occasioned by the contraction of the metal in cooling. Its fracture ought to exhibit a fine and close grain, without any air-holes; otherwise, we should find it, in working, to be a metal full of flaws and cracks.

We shall now give, after M. L. Bauhardt, a process for preparing *packfond*, which differs a little from the above. This consists in taking thirty-two parts of copper, and eleven parts of nickel, in grains; these are to be put into a covered crucible, and heated until complete fusion takes place; they must then be well stirred with an iron rod, to render the mixture homogeneous; and when the whole is in complete liquefaction, it must be poured into water, and granulated; it is then to be well dried, and again placed in the crucible; and when heated to redness, eight parts of zinc are to be added; the whole is then to be covered with a proper defensive flux, and the fire must be urged by a strong blast; and when the whole is well fused, the scorias must be removed, and the alloy be poured into an ingot mould. The alloy thus obtained, possesses, according to M. Bauhardt, a great degree of malleability, and is capable of being drawn into fine wire; and it presents the same appearance upon the touch-stone, as silver of fourteen carats.

In order to polish the various articles made of *packfond*, we commence with rubbing them with pumice-stone, next with charcoal, and then burnish them with a hard polished steel burnisher; using at the same time soap and water, or beer. When the burnisher becomes dull, it must be brightened, by rubbing it upon a piece of buff leather, impregnated with putty (oxide of tin and lead.)

When there are cavities in the work, into which the pumice-stone cannot be made to penetrate, they may be whitened, by means of a solution of silver, or of tin, diluted with water.

The soldering of the *packfond* requires a great degree of attention in applying the heat, which must be done very gradually, if we would prevent cracks or flaws in it. It is generally soldered with an alloy of the *packfond* with tin; or still better with fine silver.

In order to clean articles made of *packfond*, we may either use finely sifted wood-ashes, tripoli, or ivory-black, well washed and sifted. R.

Remarks by Thomas Gill, Esq.—The nickel is chiefly obtained in this country from the Staffordshire potteries, being procured in the extraction of the cobalt blue from its ores. In Parkes's "*Chemical Catechism*," he says, "it is generally said, that nickel has never been brought into use in England; but I have just heard from Birmingham (in 1803) that some of the manufacturers combine it with *iron*, and thus use it with great advantage; and that others melt it with *brass*, in such proportions, as forms a very handsome compound metal, exceedingly useful for many purposes. The Chinese

use nickel, in conjunction with copper and zinc, for making various articles.

"According to Proust, nickel used in certain proportions, gives a degree of *whiteness* to iron, diminishes its disposition to rust, and adds to its ductility.

"M. Richter has lately (1803) been occupied in a series of experiments upon nickel. He has found that this metal in its pure state is very malleable, nearly as brilliant as silver, and more attractable by the load-stone than iron. It is generally combined with copper; but he has found a method of freeing it from that metal. He says, that when pure, it is not liable to be altered by the atmosphere; that it is perfectly ductile, and has great tenacity. Its specific gravity, when forged, is 8,666. *Annales de Chimie, tom.* III. page 173.

"The most abundant ore of this metal is a sulphuret of nickel, called *kukfernickel*, which is generally a compound of nickel, arsenic, and sulphuret of iron.

"The valuable qualities which M. Richter has discovered in nickel, show that it might be applied to many important uses; particularly for surgeon's instruments, compass needles, and other such articles, as it is not liable to oxidize by the atmosphere. Should an easy mode of working it ever be discovered, we may possibly find this to be calculated for a greater variety of purposes than any other metal.

"It is a curious circumstance, that all the specimens of the stones which have been said to fall from the atmosphere, *contain iron alloyed with nickel.* These stones, which have at different periods been seen to fall on every quarter of the earth, are supposed by many to be cast from a volcano in the moon. Very lately a shower of them fell in Norway, which covered an extent of three-quarters of a league long, and half a league broad.

"Nickel is employed by the Chinese in making their *packfond*, or *white copper*, which is a beautiful metallic compound; but it has not been much used in Europe, although it may be had in considerable quantities."

We see now, however, that it is brought into considerable use in Europe; the Germans having employed it in many ways, and particularly in making the new musical instruments, formerly described by us, and for which it is admirably adapted; as the delicate tongues in them, are easily acted upon by the moisture of the breath, when they are made of steel, brass, or other oxidable metals.

On Making Saltpetre in France, and in Spain. By Don Guillermo Bowles.

Mr. Bowles states, that he has evident proofs that the basis of nitre really exists in the earth, and in plants, in different provinces of Spain, the same as in the *soda* of Alicant; and that any one may convince themselves of this truth, and see saltpetre with its alkaline basis, in the manufactures of Castile, Arragon, Navarre, Valencia, Murcia, and Andalusia, where it is made without the assistance of

vegetable matter; only sometimes throwing in a handful of ashes of mat-weed, merely to filtre the lie of earth; and they make excellent saltpetre by boiling the lixivium of their lands only; consequently, they have gunpowder in Spain, without being indebted for its fixed alkali, to the vegetable kingdom, there being a perfect fixed alkali in the earth.

Let us now see how saltpetre is generally made in France, and in Spain; I say nothing of England or Holland, because they make none, importing what they want from the East Indies, where it is found naturally in the earth, as in Spain, where I have seen saltpetre made with the lixivium of nitrous earth, collected in places, where perhaps there never was a tree nor a plant.

Every thing is carried on at Paris, as well as in other parts of France, according to royal ordinances, in the manner I am going to relate:---the rubbish and filth of old houses is carried to the works, and pounded with hammers; the dust is then put into casks, perforated at bottom, the aperture covered with straw, to give a free passage to the liquor. Water is then poured on this dust, which, in its passage, carries away all the saline matter. This impregnated matter is called lie, which, if they were at that period to boil, would produce saltpetre of a greasy nature; to remedy this, they purchase the ashes of all the wood fires in Paris; from which they also draw a lie that is mixed with the former, and they then boil up the whole.* In proportion as the water evaporates, the common salt, which crystallizes when hot, soon falls to the bottom of the caldron; and the saltpetre, which only crystallizes when cool, remains dissolved in the water. They draw off this water, loaded with saltpetre, into other vessels, and place it in the shade, where the nitre crystallizes. This is called saltpetre of the first boiling, having still some remains of common salt, earth, and greasy matter incorporated with it; it is conveyed to the arsenal to be properly refined, being boiled over again, and left to crystallize two or three times, or more, if found necessary; by which means it is cleared of all its impurities, and becomes perfectly adapted to the making of gunpowder, and the other uses to which it is applied in the arts.

In Spain, where a third part of all the lands, and the very dust on the roads in the eastern and southern parts of the kingdom, contain natural saltpetre, I have seen them prepare it in the following manner:---

They plough the ground two or three times in winter and spring, near the villages. In August, they pile it up in heaps of twenty and thirty feet high; they fill with this earth a range of vessels, of a conical shape, perforated at the bottom, observing to cover the bottom with mat-weed and a few ashes, two or three fingers deep, that the water may just filtre through. They then pour on the water (sometimes without putting in any ashes;) the lie that results from this

* The fact seems to be this:—the salt they obtain from the lie of the rubbish, is a nitre with an earthy basis; the fixed vegetable alkali procured from the wood ashes is then added; this alkali precipitates the earth from the nitrous acid, and taking its place, forms true saltpetre.

operation is put into a boiler. The common salt, which, as we said before, precipitates and crystallizes when warm, falls to the bottom, in the proportion of forty per cent.; the liquor is then poured into buckets placed in the shade, where it shoots, and crystallizes into saltpetre. The same earth, deprived of its nitrous quality by this process, is again carried back to the fields, and exposed to the elements; by which means, in the course of a twelvemonth, assisted by the all-powerful and invisible hand of nature, it again becomes impregnated with a fresh supply of nitre; and what is still more surprising, and cannot be observed, without admiring the wonderful works of the omnipotent Creator, the same lands have produced for time immemorial, an equal quantity of saltpetre; so that if the Supreme Power was to annihilate all the factitious saltpetre of France and Germany, Spain alone could supply the rest of the world, without the aid of a fixed alkali, ashes, or vegetables, if public economy joined hands with industry, and assisted in bringing these great points to perfection. I once asked one of these people the reason of that constant production of saltpetre; but his only answer was, "I have two fields, I sow one with corn, and have a crop; I plough the other, and it furnishes me saltpetre!" [*Tech. Rep.*

On the Spanish Iron Ore of Mondragon, in Guypuscoa; with some account of the famous Toledo Sword-blades, so greatly valued formerly in England. By Don Guillermo Bowles.

"I shall now relate some particulars concerning the famous iron mine of Mondragon, which is about a league distant from the town of that name, in Guypuscoa. It is called by the Spanish miners, '*Hierro Elado*,' or frozen iron; is found in a red clay, and produces *natural steel*, with this remarkable circumstance, that it is not to be met with any where else in the kingdom. They even preserve a traditional story, that this ore was used for those famous swords, which Catharine of Arragon made a present of to her consort, our Henry VIIIth; some of which still remain in repute in the highlands of Scotland, being suitable to their dress, and are called *Andre Ferrara*, the name of the maker, which is marked on the blades. *The famous Toledo blades*, those also of Zaragossa, called *Del Perillo*, mentioned in Don Quixote, and others, from the figure of a little dog on the blade,* were also supposed to be made of the ore of this mine, which yields forty per cent. of metal, though rather difficult to fuse.

* Cervantes endeavours to heighten the courage of Don Quixote, when he attacked the lion in the cage, by adding, "that his sword was of the common sort, and not so sharp as those famous ones with the *Perillo* mark." The Zaragossa artists had three distinct marks on their blades, viz. *El Perillo*, a little dog; *El Morillo*, a Moor's head; and *La Loba*, a wolf. Swords with the *Loba* mark, have the name of *Andre Ferrara* on them, and are not uncommon at this day in England. They show a sword in the small armory of the tower of London, with the name of Andrea Ferrara, and no other mark, which was taken in the Scotch rebellion, in 1715.

Good steel may be obtained from it with very little trouble, because the iron has in itself the proper disposition to receive, in the furnace, the necessary carbon to make excellent blades; but without cementation, it perhaps may not answer for files or razors.

"These blades were generally broad, to wear on horseback, and of great length, suitable to the old Spanish dress; but this being altered, when the Duke of Anjou ascended the throne of Spain, the French swords were introduced with their dress, which even now is commonly called in Spanish, a military dress, *vestido de militar*, in opposition to the long black cloak, universally worn there before that epocha. So that the old Toledo blades fell into disuse, and the manufacture declined; but a new manufacture of sword blades has since been set up at Toledo, for the use of the troops, and they are said to be as well tempered as the old ones, and are able to bear most extraordinary proofs; but these are not made of the ore of Mondragon.

"There are various opinions relating to the old blades we have been speaking of; some say they were only tempered in winter; and when taken out of the forge for the last time, were vibrated in the air in the coldest weather; others relate, that they were heated till they acquired that colour called *cherry-red*, and then were steeped in a tub of oil or grease, for a moment or two, and then plunged in the same manner into warm water, all which was done in the depth of winter. Others will have it, that they were made of the natural steel of Mondragon, with a list of common iron in the middle, to make them more flexible; and were then tempered in the common manner in the winter season. Such are the prevailing opinions about the blades of Mondragon, which are certainly excellent; but as to the present workmen of Mondragon, or in any part of Guypuscoa, they are yet unacquainted with the secret of converting iron into steel, or tempering it properly; and even in the making of tools, are far inferior to the artists of England.

"It is somewhat particular, that to this day, they have no other word in the Spanish language for a brick-horn, or a bench-vice, than *Vigornia*, the Latin name for the city of Worcester, thought to have been once famous for works of that kind.

"As many of the most capital workmen of Toledo quitted that city on the decline of their trade, and settled in different parts of the kingdom, where they supported the reputation of their art; and as their blades have since been dispersed all over Europe, those who are curious in these matters, will, perhaps, not be displeased to see a list of their names; as by this means they may know them whenever they fall in their way:—

Bilboa,	Pedro de Lagaretea,
Orgaz,	Pedro Lopez,
Lisbon,	Melchior Saanz, Juan Martinez Machacha,
Seville,	Sebastian Hermandez, Pedro de Lezama, Juan Martinez el Mozo,

Madrid,	Francisco Alcocer, Dionisio Corrientes, Antonio Ruiz,
Cuenca,	Julian Garcia, Andres Herraez,
Valladolid	Juan Salcedo,
Calatayud,	Luis de Nieva, Andres Munester,
Cordoba,	Alonzo Rios,
Zaragossa,	Julian de Rey,
San Clemente,	Lopez Aguado,
Cuellar and Badajoz,	Bartholome de Nieva, Calcado, Campanero.

"*The following workmen still remained in Toledo:*—

Zamorano,
Thomas de Ayala,
Juan de la Horta,
Francisco Ruiz and sons,
Juan de Vargas,
Juan de Luizalde,
Francisco Lardi,
Andres Garcia,
Heras, father, son, and grandson,
Alonzo de Sahagun and sons,
Fernandez,
Martinez.

"Any old blades found with these last names, may be undoubtedly considered as true Toledos, and executed by the most capital artists.

"Cervantes further relates, that Ramon de Hoces was famous at Seville for making of poniards. Nor should I forget the famous *Montante* of Spain, a huge weapon, used with both hands at once, so well described by Milton, speaking of Michael's sword:—

> "With huge two-handed sway
> Brandished aloft, the horrid edge came down,
> Wide wasting."—PARAD. LOST. Book VI.

"In the king's armory at Madrid, besides many curious and complete suits of armour, they had a fine collection of antique swords; amongst the rest, those said to have belonged to the Cid, and Bernardo del Carpio; also the sword of Francis I., and that of John George, duke of Saxe-Weimar, taken from him by Charles V., at the battle of Horlingen. The swords of the Cid, and Bernardo del Carpio, were made at Zaragossa; but that of Francis, at Valencia, as was the sword, likewise in the armory, of that famous hero, Garcia de Paredes, with his name on the blade, and on the other side, "*plus ultra operibus credite.*" Though these details may now, perhaps, be considered as of little moment, it was not so with our ancestors, who set a high value on these Spanish sword-blades, particularly

the Toledos; as may be collected from various passages in our favourite writers,—Shakspeare, Johnson, and Butler."

On the German Polish for Wood.

From information derived from Mr. Joseph Clement, the celebrated engineer, we were the first to publish any accurate information on the *French polish* for wood, now become so universally employed, and have continually added, from time to time, such further particulars thereon as have come to our knowledge.

Our scientific friend, Mr. J. I. Hawkins, however, having lately returned from Vienna, where he saw this process performed by an excellent workman in the cabinet-making line, and where it was invented forty years since, has kindly furnished us with such valuable information on *their superior method* of performing it, that we lose no time in communicating it to our readers.

The wood having been planed flat, and finished with the steel scraper, as in the usual processes for the French polish, has its surface evened as follows: two pieces of pumice stone, having been previously rubbed flat, are then to be oiled, and rubbed against each other, until they have acquired a uniform or even surface. The wood is then to be well rubbed with these, first longitudinally, then across, and, finally, in a spiral or circular manner, always obliterating or removing the scratches or marks made by the former rubbings, before finishing the succeeding ones; in this manner the wood will likewise receive a uniform surface, and will become ready for the application of the varnish.

The Germans never use any other varnish, than a rather dilute solution of seed-lac, or shell-lac, in alcohol, for their *polish;* and, indeed, the addition of any other material would only injure *the great hardness of the lac varnish.* If the varnish be required of *a lighter colour* than usual, in this case the clearest grains of lac ought to be selected in preference.

The varnish is applied in the following manner. A piece of *sponge* being wetted with the varnish, is to be laid upon *five pieces of linen rag,* the borders or edges of them being gathered together at the back, to serve as a handle to this rubber. When the varnish has penetrated all through these different thicknesses of linen cloth, a little linseed oil must be applied in the midst of the varnish. *The whole extent of one surface of the article to be polished, must then be gone over at once,* with this rubber; the varnish being also applied, first in straight lines crossing each other, and then in spiral or circular ones, in the same manner as in the evening the surface of the wood; and fresh oil must be applied to the centre of the rubber, whenever a tackiness or adherence of the varnish is beginning to take place. If there are four or five different articles to be polished, each should be gone over in succession, in the above manner, and thus afford time for the varnish to acquire consistence, before applying another coat of it upon the former ones. In this way the process

must be continued, with the usual care and precaution, until it is thought that nearly enough varnish has been applied to the surfaces. One of the linen rags is now to be taken off, and the varnishing continued with the remaining four, with a renewed surface, and the application of the oil upon the outer one; this again is then to be removed in its turn, and the process carried on towards completion with three thicknesses only; then with two; and finally, with one thickness of linen only.

Should the varnish be required to be of any other colour than that afforded by the lac, it may be *reddened*, by filing a little *Brazil* wood, and sprinkling the sponge over with the dust; changed *yellow*, by treating *turmeric root* in the same manner, and so with other tinging woods, the colour of which is capable of being brought out by the action of alcohol upon them.

Should, however, it be required, that *a still more durable polish* be given to the wood; then the above process must be repeated at the end of two days after the first polish has been given to it; next, in the course of a week; again at the end of a month; and lastly, at the end of three months; thus always allowing due time for the previous coats to become sufficiently hard, before applying the succeeding ones. In this manner, instead of having to lament the quick disappearance of this beautiful polish, as in the ordinary French method of doing it, we may calculate upon its enduring for years.

The German cabinet-makers do not merely content themselves with polishing the exterior of their works, but extend this beautiful improvement to the drawers, partitions, and every other part of their interior fittings also, with great addition to their value; and indeed they also take much more care in the finishing of their woods generally, than we are in the habit of doing. [*Tech. Rep.*

Observations on the manner of Manufacturing Indigo in the Southern Provinces of India; with some Remarks on its Chemical Changes and Combinations. *By* CHARLES H. WESTON, Esq.

(Concluded from page 238.)

WITH such a view of the important changes which thus occur, we see that, chemically speaking, there is no such difference in the two processes as we might be led to imagine from the varied manner of *manufacturing* the indigo. The silent and gradual change which passes upon the dried leaves in the storehouse, is precisely analogous to the absorption of oxygen which precedes, and, in this instance, continues to be simultaneous with fermentation.* It might be fur-

*Although vinous fermentation can be carried on completely excluded from the atmospheric air (*Vide* Brande's 'Manual of Chemistry,' vol. iii.) this does not seem to be the fact in the present case of common fermentation, or partial decomposition. Dr. Bancroft, in his first vol. p. 185, writes,—"But it was fully ascertained by Dr. Roxburgh, that a copious *absorption* of air from the atmosphere did occur; and that oxygen did combine with the basis of indigo in a considerable degree *during* fermentation, was manifested by the progressive changes which, as usual, constantly took place in the colour of the liquor

ther remarked, that the injury, arising from keeping the leaves after the acquirement of the "lead colour," to which I have before alluded, has its parallel in the injury sustained by excessive fermentation in the Bengal process. The period, during which the leaves are kept, appears, indeed, to be the only time in which the leaves could have received oxygen to *such an extent;* because, during the growth, as long as the sun's rays are exerting their direct influence upon them, they copiously give out oxygen gas, and, during the absence of the sun, the exhalation of carbonic acid gas, necessarily employs another portion of oxygen.*

Before quitting this part of the process, I will here state another experiment on the solution of *green* leaves in cold water, because, while it at first appeared completely to upset the conclusions I had deduced from former experiments, it did, upon subsequent consideration and examination, strongly confirm the truth of them.

Green leaves steeped in *cold* water for fifteen minutes began to tinge the water with a *greenish* yellow. Leaves from the same plant, after five hours' boiling (the loss of water by evaporation being constantly supplied,) gave out a proper extract of indigo; and from another portion of leaves, after twenty-four hours' digestion in *cold* water, the *whole* of the indigo was precipitated, and the supernatant liquor clear, and of a good "brandy colour." These were unexpected results, and they seemed to throw a doubt over the consequences of every one of the former experiments: my first inquiries and examination were, therefore, directed to the plants from which the leaves had been taken. I found the plant had been cut *one month* previously, and that the leaves were some few under leaves remaining on each plant of the *former* crop. Now, as the leaves had become ripe one month before, they had arrived at, and passed, the maximum capabilities of their physical powers; and their organs had long ceased to perform their proper functions in decomposing carbonic acid, and of exhaling oxygen gas. We know that fruit, when ripening, absorbs oxygen,† although allowed to remain on the tree, and the same tendency doubtless exists in the whole vegetable world in a greater or less degree. The leaves subjected to the above experiment had assumed a much darker green than leaves possess at the proper time for cutting, and as they had passed beyond the full period of strength and health, they could have no other tendency but to absorb oxygen.‡ They had then, consequently,

during the fermentation until it acquired a full green, and even a bluish colour, the froth, or scum, becoming, more or less, blue at the same time." See, also, p. 176.

* I have qualified this remark by adding, "to such an extent," because it is not intended to intimate that either during the day or night the balance of oxygen is not *in favour* of the plant. The contrary, in both cases, is clearly proved by the experiments of Saussure, as mentioned in Thomson's 'System of Chemistry.'

† M. Berard of Montpellier has showed that fruits, in ripening, convert the oxygen of the air into carbonic acid.—DAVY's *Agricul. Chem.* See, also, Dr. SMITH's *Botany*, p. 155.

‡ *Vide* Sir H. DAVY's *Agricul. Chem.* p. 207—209.

been undergoing, for at least three weeks, the same process, though perhaps in a less degree, which the leaves in the warehouse had experienced, and had absorbed on the plant, that given quantity of oxygen which is necessary to render the colouring matter of the leaves soluble in water. Such a view of the subject reconciles all apparent difficulties.

The difference in the effects of ebullition upon the green leaves, in Experiment No. 4, and upon these in the last experiment, in reference to extent, can be easily explained, on the supposition of a previous absorption of oxygen; since, within certain limits, matter has its affinity for oxygen increased in a kind of geometrical ratio by the previous absorption of oxygen.

From this last experiment we get possession of this important fact, that in practice, the age of the plant, and the time for keeping it, should always be in an inverse ratio; that is, *if from fear of rain the plant be cut too soon, the leaves should be kept a little longer; and if from want of sufficient sunshine the cutting be deferred till after the plant is fully ripe, the leaves will not require to be kept so long.*

We now suppose the indigo leaves, after their due keeping, ready to be transferred to the "steeping vat,"* where they are commixed with water, in the proportion of about one volume of leaves to six of water, and allowed to remain for two hours. The great affinity of indigo for oxygen is here very manifest, in the quick change of the colour of the leaves which float on the surface, and are exposed to the action of the atmosphere, to a blackish blue, when contrasted with those below which remain unchanged. On this account the vat is, every now and then, "turned," that is, the floating leaves are immersed. This steeping part of the manufacture constitutes the characteristic difference between the green and the dry process. In this instance, it is a simple *infusion* of the leaves without fermentation; in Bengal, the branches, together with the leaves, are steeped and allowed to *ferment.*

After two hours' infusion, the water, which, from the solution of imperfectly-oxygenized indigo, has acquired a fine green colour, is allowed to run off from the leaves through strainers into the "beating vat." Two hours are generally supposed to be sufficient to extract all the colouring from the leaves, and the following experiment seems to confirm this supposition.†

"Refuse leaves of indigo taken from the vat, and quickly rinsed,

* A vat is an uncovered reservoir, built of brick, and lined with stucco prepared from burned shells; it is usually about thirty feet square, and twenty-six inches deep.

† Whatever may be the necessity of making use of *hot* water for obtaining indigo from the leaves of the nerium tinctorium, or the advantages to be derived from its use in the fermentation of the indigofera tinctoria, which Dr. Roxburgh mentions, no possible advantage can be derivable from such management in the dry process; because, as we find that the solvent power of cold water is quite sufficient to extract the whole of the blue colouring matter, an increase of that power, by the addition of caloric, could only have the effect of dissolving other substances which are foreign to the dye.

to remove any indigo externally adhering to them, were digested in cold water for one additional hour. They gave to the water a pinkish colour, but no *green* tinge, from which was obtained, by a solution of acetate of lead, a delicate whitish yellow precipitate." My observations, of course, refer to leaves properly kept and properly dried; because, if prematurely put into the vat, the time necessary for the entire extraction of the indigo would be much greater. But the green liquor cannot be allowed to remain so long upon the leaves, because a partial precipitation of indigo would take place before it passed into the beating vat.

In the beating vat the solution is agitated by the paddles of ten or twelve natives for about two hours, during which time the fine green liquor gradually darkens to a blackish blue. No precise time can be laid down for the continuance of this part of the process, as the absorption of oxygen, which is thus effected, and hastened by beating, and the consequent continual exposure of some new portions of the liquor to the atmosphere, depends on circumstances, such as the former preparation of the leaf, and the immediate influence of the sun.*

The only criterions to guide us, are—the peculiar black hue of the liquid, the whiteness of the froth thrown up by beating,† and the incipient separation of the particles of the indigo. This last effect can be easily seen by placing a small quantity in the palm of the hand, and more distinctly by pouring some into a white plate.

At this time lime-water is thrown into the vat, and well immixed with the liquor. The whole is then allowed to rest for three hours, and the supernatant liquor, which is, or ought to be, of a fine bright Madeira colour, is allowed to run away from the precipitate, by cocks placed at different heights. The indigo is then removed from the vat to the covered part of the manufactory called the laboratory, where it is put on a strained cloth, and allowed to drain throughout the night.

But as the beating process is the most material part of it, so it is here that we most sensibly feel any improper management with regard to the leaves. Premature cutting of the plant, imperfect desiccation of the leaves, and even the previous occurrence of much cloudy weather, while the plant was growing—show their bad effects in the necessity of a much more lengthened beating, and in imparting to the froth a green colour, which, otherwise, as the oxygen was absorbed, would, by a precipitation of the indigo, have become white. When the two first evils are to a greater extent, no beating will precipitate all the indigo, and, consequently, much will be lost. The supernatant liquor, instead of being of a fine Madeira colour, will remain a dark, dingy Madeira colour.‡ The following experiments will give force to this observation:—

* It has been before remarked that the vats are uncovered, and therefore exposed to the direct rays of the sun.

† This must be regarded with some limitation, as we shall see soon what will prevent sometimes the whitening of the froth.

‡ Dr. Bancroft confirms this remark.

"A quantity of Madeira colour liquor left after the manufacturing of indigo improperly dried, was reduced by boiling to one-third its bulk. The colour was deepened, and the smell of it highly saccharine, and *blackish indigo was precipitated.* At this time the yellow extract of the liquor appeared to begin to separate. The liquor, after the removal of the precipitated indigo, was boiled for other seven hours, supplying the loss occasioned by evaporation: *more indigo* was precipitated, combined with some of the extract."

Again, "Another portion of the Madeira colour liquor was first exposed to the action of the atmosphere for seventeen hours, and then beaten for two hours. The solution became greenish by the additional absorption of oxygen, and a *little indigo* was precipitated."

As, therefore, the quantity of the precipitation depends upon, and is in proportion to, the oxygenation of the indigo, the importance of carrying on this beating process to its maximum to obtain the whole colouring matter is evident; but there is another extreme to be avoided.

When indigo is combined with a certain quantity of oxygen, its colourless base acquires a blue colour; but after this point is passed, and a further combination of oxygen has taken place, the colouring matter passes from a blue to a blackish-blue, and the indigo is technically said to be "burnt." If beating be carried on still further, the granulated indigo becomes specifically lighter, and a partial resolution of it follows, and it is therefore unavoidably lost. Each of the different effects here mentioned will be more clearly pointed out and understood, by perusing the following memorandum:

"A green solution of indigo from the vat was agitated for ten hours. The supernatant liquor, instead of being a fine clear Madeira colour, became like burnt umber—resulting from a partial resolution of the indigo. The indigo became specifically lighter, and remained floating in the menstruum. The whole was filtered, and the indigo properly pressed and dried, and the cake when broken was *black.*"

Beating, strictly speaking, is not essentially necessary to the formation of indigo, but is rendered expedient by the *accumulation* of the green solution in one place, and the consequent non-exposure of a great part of it from the influence of the oxygen of the air.* I make this remark, because I have found that portions of the green liquor could be *completely* oxygenized by bare exposure to the atmosphere, without agitation. "Made a solution with indigo leaves, filtered it, and divided it into two equal parts, one part of which (No. 1.) was exposed to the direct influence of the sun's rays, and the other (No. 2) was kept in a dark place. The first portion was considerably in advance of the other throughout the process, so that

* This remark will serve to render evident the expediency of precipitates, although, as we shall soon see, they be not necessary in the small way. Dr. Roxburgh well describes their utility, when he says:—"If well chosen, and in proper proportions, they forward the operation *much*, causing a *larger* produce than could be had without them." His advice as to the time for using them, is worthy some attention.

when No. 1, in two hours and a half, was completely precipitated, leaving the supernatant liquor a fine clear Madeira colour, No. 2, in the same time, was but partially precipitated, and the supernatant liquor remained greenish. After longer exposure, however, the whole indigo of No. 2 was also precipitated."

By this experiment we learn, not only that a complete precipitation can take place without beating, but without the assistance of lime-water. We also learn that sunshine can hasten the beating process, as I before remarked; the great affinity of indigo for oxygen enabling it to separate and combine with that gas, which always coexists with the least refrangible rays of light.*

Having said thus much on this most important part of the manufacturing process, I shall now make some observations upon the yellow extract of the leaf, which has been denominated "the supernatant Madeira-colour liquor." We see that the indigo leaf imparts to water two distinct colouring matters—the blue and the yellow; and that a solution of the latter, when a complete precipitation of the indigo has been effected, is bright and clear. This extract appears to have many qualities in common with the blue. From experiments already detailed, it has, like indigo, an affinity for oxygen (although, indeed, in an inferior degree,) its colouring matter is capable of being deepened by the absorption of oxygen, and by a further absorption in part precipitated. Its affinity for indigo is also great, for it is always combined in some degree with the granulated indigo: and when the yellow dye ceases to be given out from it to *cold* water, *hot* water will extract another portion, as we shall by and by see; and again, after the whole process is completed, pounded indigo will afford more colour to boiling water.

I have found that a solution of acetate of lead will throw down from this Madeira-colour liquor a fine yellow precipitate; and that this, when filtered and gently dried, remained unchanged after an exposure to the air for nine months. But a more delicate yellow colour can be procured, by adding acetate of lead to a filtered green solution of indigo from the steeping-vat, when the indigo is first precipitated combined with the salt, leaving the supernatant liquor clear. To this solution, filtered, again add acetate of lead, and the precipitate will be a fine yellow, brighter than that separated by beating.

I endeavoured to fix that colour on cotton-cloth, and found that, by frequent alternate steeping the cloth in this Madeira-colour liquor, and drying it, and so saturating it with the colouring matter, and subsequently steeping it in a solution of acetate of lead, an insoluble precipitate was effected between the fibres of the cloth; and the yellow colour was imparted. But I have not followed up this experiment, and therefore can say nothing of the permanency of this colour alone, or when protected by an after dip in the blue vat for obtaining a green; or how the colour may be affected by aluminous

* *Vide* "Light and Caloric."—THOMSON's *Syst. of Chem.*, and URE's *Chem. Dict.*

and other mordants. I have nevertheless thought that some notice should be taken of this experiment, imperfect as it really is, that it might serve as a hint to some scientific indigo-planter, whose numerous opportunities will enable him to try whether the immense quantities of colouring matter now daily allowed to run to waste can be turned to any advantage.

I have said that the indigo leaves produce two dyes—the blue and the yellow; strictly speaking, however, there is yet another colour which may be thus obtained. The refuse leaves taken from the vat, and well washed, to remove all colouring matter adhering to them, when boiled for an hour and a half, will render the water yellow, tinged with green. This water, kept in full ebullition for two hours (supplying the loss occasioned by evaporation,) will, when filtered, afford a precipitate, which, when dried, will in colour be a dun-slate, and in quantity perhaps about equal to the blue extract such leaves have produced. This observation, as it can lead to no practical advantage, is made for the man of science, rather than the man of business. The precipitate appears to be very impure, and mixed with some of the finer parts of the fibres of the leaves.

We now revert to the manufacturing process. The precipitated indigo left in the vat was transferred to the cloth-strainer within the laboratory, and allowed to drain throughout the night. On the following morning, the indigo is put into the copper, with a quantity of hot water, and raised to ebullition. As the mass is gradually heating, a quantity of scum rises, which is immediately removed, and as soon as the whole is brought to the boiling point, the fire is withdrawn. The contents of the copper are retaken to the strainers, and the drained indigo is then divided into small portions, and each portion well worked by the hands of the natives. This manipulation is continued till the indigo be freed from air-bubbles, and has assumed a close, fine, and smooth appearance. The whole is then carried to the pressing-boxes, which are usually square, and of sufficient depth to leave the cake about two inches and a quarter in thickness. By means of a powerful screw, the water is separated from the indigo, which is then left in a large square cake. This is subsequently cut into small cakes, which, gradually dried in the shade, and carefully protected from the hot land-winds, are thus rendered fit for exportation.

This last part of the process I have described as succinctly as possible, because I felt I was travelling over a path already well trodden; but I could not wholly pass it over, as I wished to make some observations upon the *uses* and *effects* of boiling, as they have occurred to my mind, and which I have not seen mentioned in any work upon indigo. Dr. Bancroft, indeed, speaks of boiling indigo in copper vessels, but this was boiling indigo in a weak solution of soda, for the *sole* purpose of removing impurities, and, therefore, differs from that we are now considering.

The first effect of boiling appears to be *a condensation of the particles of indigo*, because I have found that the aggregate quantities of indigo and water, when taken out of the copper, show a much

greater deficiency than could possibly, I think, have resulted from loss by evaporation.

Another advantage arising from boiling, is, I should say, the *removal of much extraneous colouring matter* from the indigo. I have before observed that the affinity between the yellow dye and indigo is such, as always to combine with the precipitated indigo. Cold water, whether affused over, or digested upon, this precipitate, extracts no colour, but the hot water in the copper is always as strongly tinctured with the brandy colour as the supernatant liquor of the heating vat.

Another advantage derivable from partial boiling is *an improvement of the hue* of the indigo, occasioned, I infer, by an additional absorption of oxygen. Experience has shown the observant manufacturer, that indigo, when boiled, possesses a purplish hue, which indigo carried from the strainers to the pressing boxes does not possess; experiments before detailed, prove that oxygen is absorbed during ebullition, and even to such an extent as to precipitate indigo—and oxygen we know to be the direct cause of colour;—we may therefore fairly infer, that the improvement of tint in the copper is occasioned by its absorption. The following memorandum will perhaps throw some light upon this part of the process, and give us some caution as to the extent to which it should be carried:—

"Boiled indigo for seven hours after its own proper boiling, and constantly supplied the loss of water: thrown upon the filter, the separated liquor was a good brandy colour. The indigo pressed and dried proved to be a *dead* blue."

From this we learn, first, that after the fine purplish hue has been acquired, we have arrived at the maximum of improvement in colour, and that any further accession of oxygen deteriorates the colour. And, secondly, that the oxygen so absorbed by boiling, is in a proportion far less than during the beating process.*

Another use of boiling is the throwing to the surface a quantity of scum, which is usually said to consist of resinous impurities; but of this I would affirm nothing, inasmuch as I have never examined the chemical qualities and nature of this substance.

I have now given a pretty full account of the dry process of manufacturing indigo; in detailing which, my object has been to give some chemical rationale of the different parts of the process, to venture suppositions respecting the nature of those changes to which the plant is necessarily subjected; and at the same time to point out the grand characteristic difference between the steeping and the fermenting modes of manufacturing.

This paper, I am aware, cannot be considered sufficiently comprehensive in matter, as it by no means imbodies the whole process, practical and theoretical; and I doubt not, but, to the chemist, many of the preceding pages afford abundant specimens of much that is superficial, both in observation and in scientific knowledge. I was,

* Compare this experiment with that in which the effects of excessive agitation were related.

however, alone induced to offer any remarks upon such a subject, from the conviction that the almost entire absence of information would give to them a kind of artificial interest which otherwise they could not have possessed. It is but justice, indeed, to myself, to add also, that these memoranda were originally never intended for the perusal of a second person, but that they formed the first experiments I ever made on the interesting properties of indigo. These I had fondly hoped, at some future period, to have extended so far as to give myself a full insight into the whole process, for much additional examination is absolutely necessary. Some of the advantages, for example, of boiling the indigo, as they have struck my mind, have indeed been alluded to, but more experiments and closer attention may bring to light other, and, perhaps, more important effects, than some of those already mentioned. So, also, with respect to the other parts of the process, which I consider rather as an outline to be filled up by future observations. With proper apparatus, and a little perseverance (as almost every part of the manufacture may be conducted under receivers, &c.) not only may the nature of the changes which are constantly taking place be clearly and unquestionably explained, but the quantities of gases absorbed and evolved be correctly ascertained.

Circumstances have prevented the possibility of my renewing such delightful employments; I therefore leave my observations, unsatisfactory as they may be, as hints to others, who may have both opportunities and abilities to investigate the subject throughout all its bearings. [*Quarterly Journal.*

On the Early History of the Steam Engine.

A PAPER on this subject, and particularly on the rival pretensions of France and Great Britain, published by M. Arago, in the "Annuaire du Bureau des Longitudes" for 1829, has excited more attention than might have been thought due to so hacknied a topic. The cause of that attention will, perhaps, be found in the preface by which the paper is introduced, and of which the following is a translation.

"The steam engine has rendered such important services to industry and navigation, that we cannot be astonished at the eagerness with which various nations have disputed the honour of the invention. Yet it will not be heard without surprise, that in England alone one hundred thousand copies of the works in which this historical question is discussed, have been sold within a very few years. Such striking success is due, I doubt not, principally to the lively interest which the steam engine must naturally excite in a country where it is met with at every step; but may we not suppose that self-love has had some share in producing this effect? Ask the member of the House of Lords, and the most simple artisan; the merchant whose speculations have led him into every region of the world, and the farmer who has never passed the borders of his own county; traverse

the manufactories of Birmingham, Manchester, and Glasgow, and the humblest workroom of a cottage; every where you will hear that the first inventor of the steam engine was the Marquis of Worcester. Every where this name will be cited, and it will be followed by those of Savery, of Newcomen, of Beighton, of Watt, of Hornblower, of Woolfe, &c. &c. Literary men, and those who cultivate the sciences, have, in general, opinions no less decided. If you open the recent Encyclopædia of Dr. Rees, you will find this passage; 'the steam engine follows next to the ship in the order of inventions, but in an English Encyclopædia it will take the lead, from the circumstance of its being wholly invented and brought into general use by our own countrymen.' And then, as if this were not sufficiently clear; 'the steam engine has been invented by a small number of individuals, all of them Englishmen.'

"The celebrated professor John Robison, of Edinburgh, is quite as positive. He says, 'the steam engine was, beyond all doubt, first invented by the Marquis of Worcester, in the reign of Charles the Second.' Then, after having refuted by arguments, which I will examine, the pretensions of those French authors who affect to mix up the name of Papin with the history of the steam engine, Robison declares, 'that he does not hesitate in giving the honour of the first and complete invention to the Marquis of Worcester.' A philosopher, not less illustrious for the profoundness of his knowledge, than for the vastness of his erudition, Dr. Thomas Young, has joined his imposing testimony to those I have quoted. According to him, the Marquis of Worcester is the first inventor of the steam engine, the first who has used the pressure of vapour as a prime mover. In the rapid view which he takes of the ameliorations which this machine has successively undergone, no names appear but those of Englishmen. I could also cite the able professor of Mechanics at the Royal Institution, Mr. Millington; a distinguished member of the new University of London, Dr. Lardner; the author of an esteemed Treatise on Mechanics, Mr. Nicholson, &c. &c.

"Decisions so numerous, so positive, the just reputation of the works from which I have quoted them, would seem to exclude the shadow of a doubt. When, therefore, at the desire of the pupils of the Polytechnic School, I attempted, some years since, to trace the chronological series of improvements in the steam engine, from its origin till our own time, I expected, I say it without equivocation, to have only English mechanics to cite. This was, however, a mistake. Our neighbours on the other side of the channel are not the sole, neither are they the first, inventors of the steam engine."

The last paragraph of this preface will explain the reasons for the extraordinary notice which has been taken of the paper. It has been supposed that the dispute was as new to every body, as M. Arago describes it to have been, a few years since, to him. But the fact is, that the dispute, if it may be so called, is as old as the steam engine itself, and it has been kept constantly alive for the last hundred years, as every one acquainted with the works of Belidor, Bossut, Montgery, and many others on the continent and in England, must

be fully aware. The first of these writers alludes to it in his "Architecture Hydraulique," published in 1725, and concludes thus: "a proof that the steam engine had its origin in England, is obtained from the fact, that all the engines erected out of England have been the work of Englishmen." After this testimony by a Frenchman, writing when the facts were fresh in the recollection of the scientific world, it is almost too much to charge all the English writers (one only excepted) with having sacrificed the truth to their national prejudices; and especially when this is coupled with such an extraordinary demand on their credulity, as is made by the assertion that *a few years since* M. Arago imagined that none but English names had been associated with the history of the steam engine. If M. Arago were thus ignorant of the facts, the circumstance is evidence of suppression or neglect, not so much on the part of the English, as on the part of the French writers, who on this subject are numerous and voluminous, and with whom M. Arago could not have been unacquainted. If, a few years since, M. Arago did not know that France had produced the steam engine, we may presume that it was a fact not generally known in France. If, then, France had forgotten her own work, England might have been pardoned for not recollecting it.

The best reply to M. Arago's paper will consist in a brief exposition of every known step in the application of elastic vapour to the production of motive forces; from which may be deduced the real value of those facts which the English are incorrectly charged with suppressing, and from which also will be seen how unnecessary was the following declaration of M. Arago: "Mes citations, mes analyses, seront exactes; on peut y compter." It is not usual for scientific writers to premise that they are not going to falsify their extracts; the name of M. Arago would have been considered a sufficient security against such a proceeding. It will, however, be found in the sequel, that some of the *citations* are not quite *exact*, and that the variations are always in favour of the writer's hypothesis; but it would never have been supposed that the variations were made designedly, even without the singular protestation before quoted.

The earliest known suggestion for the use of steam, is one made about one hundred and thirty years before Christ, by Hero, of Alexandria, and published in his "Spiritalia." Its principle and mode of action will be understood from *Fig.* 1, where *a* represents a globe moving freely on its axis in such a manner as to permit the constant introduction of steam from a detached boiler. The steam escapes through the bent tubes *b*, *b*, and gives, by its reaction, a rotary motion in the direction of the arrow.

Fig. 2, describes another apparatus of Hero, in which *a* is a globe half filled with water, which is partly converted into vapour by exposure to the sun. A pressure is thus occasioned on the surface of the water, which is consequently driven up through the syphon *b*, into the cup *e*, whence it descends by the pipe *d*, into the close vessel *c*, also half filled with water. When the globe *a* cools, the water it contains is relieved from the greater part of its pressure by con-

densation, and the water rises from the vessel *c*, through the pipe *f*, to supply what had been driven over by the elasticity of the vapour. Thus the water is alternately expelled from, and restored to, the globe, by the alternate production and condensation of elastic vapour.

Fig. 1.

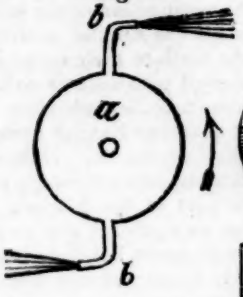
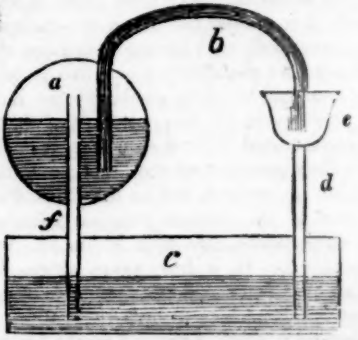


Fig. 2.

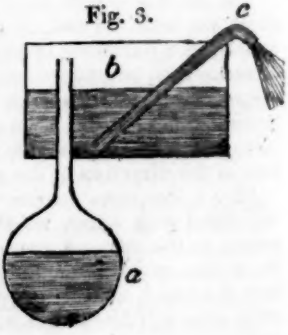


It is obvious that the engraving in this case is a mere diagram; that the apparatus would require a valve opening downwards in the pipe *d*, and another opening upward in the pipe *f*. They are omitted in Hero's diagram, most probably for the reason, that the use and application of such valves were then too well known, and too obvious to require notice.

The first of the two contrivances above given, is quoted by M. Arago. The second he omits, though both are contained in all the editions of Hero's well known treatise. In this case, therefore, the *citation*, if not *inexact*, is *incomplete*, and it happens that the second apparatus anticipates the principle of both the contrivances on which M. Arago builds his theory, that the steam engine is a French invention.

A translation of the work of Hero was published in Italian, by Baptista Porta, in 1606. He repeats Hero's inventions, and adds the following of his own, illustrated by a diagram, in which is shown the furnace for heating the water. In *Fig.* 3, the furnace is omitted; in other respects it is a copy from the work of Porta. The boiler, *a*, has a long neck, which passes through the bottom of the close cistern *b*. A bent pipe or syphon, *c*, is closely fitted into the top of the cistern, and descends nearly to the bottom. When the fire is lighted under *a*, the steam ascends into the cistern, presses upon the water, and forces it up the syphon, *c*, whence it runs in a stream.

Fig. 3.



This is altogether a very extraordinary suggestion, and considering how well known must have been the works of the celebrated Baptista Porta, it is surprising that the project was not sooner reduced to practice than is found to be the case. The contrivance is a great improvement on that of Hero, (not because artificial heat is employed, for it is obvious that Hero proposed to use solar heat, merely for the sake of variety, but) because the steam from heated water in one vessel is made to drive up cold water from another vessel; instead of driving up the heated water from which the steam is produced. With this important modification, the apparatus resembles that proposed by the Marquis of Worcester, in 1663, excepting only in the extent of its power. The difference is merely one of degree. Porta's drawing and description, put into the hand of any intelligent workman, could not fail to realize all that the Marquis of Worcester hinted at in regard to the steam engine.

This apparatus of Baptista Porta is neither described nor alluded to in the paper of M. Arago, which professes to give every suggestion of importance; of course it was unknown to him; but he cannot avail himself of this apology without recollecting that English writers on the steam engine might have had the same apology for omitting French contrivances, which he must resort to for neglecting that of an Italian. It is not admitted that the English writers have omitted to notice any French invention of the slightest consequence; but if they had, the case of M. Arago and the Italian, will, for the future, suggest to him other causes for such an omission than national prejudice and self-love.

Only nine years after the publication of the work of Baptista Porta, that is to say, in 1615, appeared a treatise on *Moving Forces*, and especially on the means of raising water. The author does not profess to give new inventions, nor is there the slightest reason for ascribing to him *that* which will presently be considered. He says, "there *are* five means of elevating water above its level," which means he then describes, and which were then all of them old, most of them 2000 years old. They are, in fact, brought forward as *existing* inventions, and some are expressly referred to their authors.

The *first* mode of raising water, he says, is by the syphon. This instrument was older than Hero.

The *second* is by the well known operation of capillary attraction.

The *fourth* is by the action of compressed air, illustrated by Hero's fountain, and ascribed to Hero.

The *fifth* is by animal labour applied to machinery, such as the screw of Archimedes, or the pump of Ctesibius.

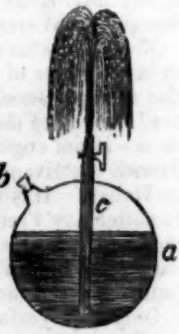
It would evidently be absurd to call the writer of the book in question the inventor of any of the four apparatus above described. He himself makes no greater claim to the third than he does to the others, and the works of Hero and Porta show that he *has* no claim; yet it has been very improperly conceded to him by several English writers;—by several of those writers whom M. Arago charges with suppressing the evidences of the French title. The reader will guess that the work above quoted is a French work, and that we now ap-

proach the period at which France invented the steam engine. The work was written by Salomon de Caus, whose name and pretensions were familiar as household words to the English, through the medium of English books, for years before M. Arago rescued them from the oblivion in which he says English prejudice had buried them. But to return to the fact, that the steam engine is on the point of being invented in France by Salomon de Caus.

The invention of this mighty agent, and its announcement to the world, fully justify the epithet which M. Arago gives to the inventor, when he calls him the "modest Salomon de Caus."

The announcement forms the *third* of the means which De Caus says *are* in existence for raising water.

Fig. 4.



"The *third* means is by the aid of fire, for which various machines may be made;" and he proceeds, "I shall here give the demonstration of one. Let there be a globe, *a*, having a valve, *b*, to introduce water, and a tube, *c*, soldered into the upper part of the ball, and descending nearly to the bottom; after having filled the ball with water, and well closed the valve, place it on the fire; then the heat, acting on the ball, will cause the water to ascend through the tube, *c*."

Nothing can be better than this as an illustration, in a general treatise, of the means by which water may be elevated; and nothing could be more ridiculous than to put this forth in 1615 as an invention; for, during the previous fifty years, Europe had been deluged with translations of Hero, and only nine years before had appeared a full description of the apparatus of Porta, to which this is so obviously inferior, that it would be an insult to the reader to say why.

It must, however, be recollected, that Salomon de Caus is not himself chargeable with the absurdity of calling this contrivance either new or useful; he most probably omitted the cold water vessel of Porta, because he equally well explained what he wished without it; namely, the simple and well known fact, that the elastic power of steam might be used to raise water.

It is scarcely credible that the hot water fountain described in *Fig.* 4, neither possessing nor pretending to the slightest feature of novelty or utility, is what M. Arago calls the invention of the steam engine in France, and the publication of which, by de Caus, entitles him to be called "un homme que la postérité regardera, sans doute, comme le premier inventeur de la machine à feu."

This case, as far as regards the claim made in behalf of France and de Caus, may now be left to the reader; but it remains to consider it in reference to M. Arago's protestation, "mes citations seront exactes, on peut y compter."

The diagram, *Fig.* 4, is accurately copied from the work of de Caus; the diagram given by M. Arago as an extract from the same work, is represented in *Fig.* 5, where it will be seen that the tubes *b* and *c* are indefinitely elongated, and the jet of water omitted. This is, of course, an accidental variation, but it renders the assertion of M. Arago, that the apparatus is a "proper machine for draining," a little less amusing than it would have been without this example of the *exactness* of the *citations.*

Fig. 5.

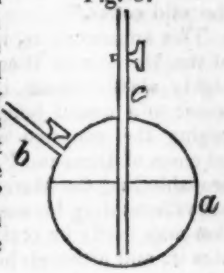


Fig. 6.

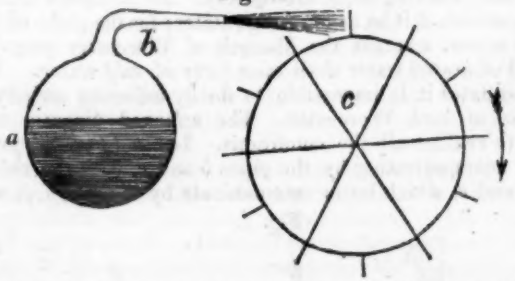


Fig. 6 describes an apparatus proposed in 1629, by Branca, an Italian. The boiler, *a*, terminates with a bent tube, *b*, from which the steam issues, and impinges upon the vanes of a wheel, *c*, which receives motion in the direction of the arrow. There is very little novelty in this contrivance; the principle does not differ from the first apparatus of Hero, and the practical effect would probably be inferior.

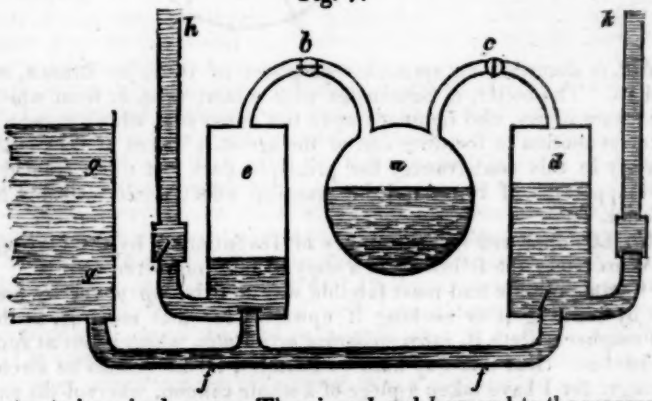
In 1663 appeared the "Century of Inventions," by the Marquis of Worcester; the following is a copy of that numbered 68.

"An admirable and most forcible way to drive up water by fire, not by drawing it or sucking it upwards, for that must be, as the philosopher calleth it, *intra sphæram activitatis*, which is but at such a distance. But this way hath no bounder, if the vessels be strong enough: for I have taken a piece of a whole cannon, whereof the end was burst, and filled it three-quarters full of water, stopping and screwing up the broken end, and also the touch-hole, and making a constant fire under it, within twenty-four hours it burst, and made a great crack; so that having a way to make my vessels so that they are strengthened by the force within them, and the one to fill after the other, I have seen the water run like a constant fountain-stream forty feet high; one vessel of water rarefied by fire, driveth up forty of cold water. And a man that tends the work is but to turn two cocks, that one vessel of water being consumed, another begins to force and refill with cold water, and so successively the fire being tended and kept constant, which the self-same person may likewise

abundantly perform in the interim between the necessity of turning the said cocks."

This apparatus, is, in principle, the same as Porta's. The merit of the Marquis of Worcester consists in having suggested the use of highly elastic steam, in exceedingly strong vessels, so as to raise water to a useful height, as forty feet. He has also the merit of urging the adoption of this plan on the large scale, whereas the schemes of Hero and Porta were mere experimental toys. It is most probable that the Marquis never tried this apparatus on a large scale, notwithstanding his assertion to the contrary; but that his description may easily be realized there is no doubt, though M. Arago denies it, and although he says that Mr. Stuart could not realize it, otherwise than by grouping together two of the vessels of Salomon de Caus, and working them alternately. Mr. Stuart's description is very incorrect, if it be as M. Arago states; for the globe of de Caus ejects hot water, whereas the Marquis of Worcester proposes that one vessel of *heated* water shall raise forty of *cold* water. This M. Arago insinuates it is impossible to do by adhering strictly to the description of lord Worcester. The annexed diagram appears, however, to realize all the conditions. Let *a* (*Fig. 7*,) represent the boiler communicating by the pipes *b* and *c*, with the cold water vessels *d* and *e*, which latter communicate by the pipe *f*, *f*, with the

Fig. 7.



water to he raised, *g*, *g*. The pipes *h* and *k* ascend to the reservoir, forty feet above, and their lower ends enter the cold water vessels *e* and *d*. The two cocks, *b* and *c*, are those which are described to be opened and shut alternately. The four valves in the pipes *f*, *h*, and *k*, are precisely such as had been used for nearly two thousand years in pumps. The vessels *d* and *e* are in fact forcing pumps, in which steam is substituted for a solid piston. The cock *b* is in the diagram open, the steam is therefore forcing the water out of *e*, and up the pipe *h*. The cock *c* is closed, and the vessel *d* is cooling; the water tends, therefore, to enter it both from the cistern *g*, *g*, and from the pipe *k*; the arrangement of the valves, exactly like those of a pump, prevents the latter and permits the former: therefore, the

vessel *d*, as it cools, is filled from the cistern *g*, *g*. This action would, no doubt, go on alternately, by maintaining the fire, and alternately opening and shutting the cocks *b*, *c*; and it is quite certain that this proposal more nearly resembles the first steam engine known to have been made, than any prior invention. In this diagram, the most unfavourable case is taken for the Marquis, because there is nothing in his description to forbid our concluding that he would have availed himself of what was then well known, the vacuum formed by the condensation of the steam. He would then have placed the vessels *d* and *e* twenty or thirty feet above the water, *g*, and in this shape it would be very nearly a perfect anticipation of the first working steam engine.

On the whole, very little credit is due to the Marquis of Worcester. The majority of his hundred projects are either absurd or puerile: some are impossible to realize, many are not worth realizing, many contain no novelty, and several have a taint of the perpetual motion. All this is so evident, that it would hardly have been thought worth while to mistranslate the Marquis, in order to make his one rational project as absurd as many of the others; yet this M. Arago does.

The Marquis says, "my vessels are strengthened by the force within them." This has been usually translated by French writers, "mes vaisseaux sont fortifiés intérieurement." M. Arago translates it, "des vases qui *se fortifient* par le *développement* de la force intérieure." He says that he is aware that the rendering of former translators is more reasonable than his own, but that it ought to be made extravagant to correspond with the other projects of the Marquis. M. Arago has certainly succeeded in making the Marquis absurd, for he supposes him to mean that the stronger the steam, that is to say, the greater the strain to which they are exposed, the stronger will be the vessels; and, in order to bear out this assumption, he alters the whole passage. Lord Worcester says, "the vessels are strengthened." M. Arago translates it, "des vases qui *se fortifient*." Lord Worcester says, "by the force within them." M. Arago translates this, "par le *développement* de la force intérieure;" the word "*développement*" is gratuitously introduced, to assist the first misrepresentation, and to help the insinuation that it was proposed to strengthen the vessels by the strength of the steam; for the word *développement* is unintelligible as applied to a constant source of strength; it must mean something which fluctuates in the vessel, and there is nothing which does this but the steam.

[TO BE CONTINUED.]

AMERICAN PATENTS.

LIST OF AMERICAN PATENTS GRANTED IN AUGUST, 1829.

With Remarks and Exemplifications, by the Editor.

1. For improvements in the *Preparation of Hemp and Flax for Spinning*, consisting of instruments for dressing, or sepa-

rating the hurl, in either a rotted or unrotted state, and shortening the hurl and fibre, in such a manner as to be drawn, roped, spun, and woven, the same as cotton or wool; La Fayette Tibbitts, New Amherst county, Virginia, August 1.

The specification of this patent commences with the observation that the hemp and flax dresser in general use in this country, is a French invention, patented by Messrs. Hines and Bain; which consists of several pairs of horizontal fluted rollers, so arranged that the flax, or hemp, to be broken, passes between them in succession, there being a feeding and receiving apron, and other necessary appendages.

The improvement now proposed, consists in arranging the rollers in pairs around a large spur wheel, there being pinions on the ends of the lower, or inner rollers, taking into the teeth of the spur wheel; the feeding and receiving aprons being fixed so as to suit the arrangement of the rollers.

"The part of the preparation of hemp and flax, by shortening the hurl or fibre, consists in cutting, pulling, or tearing to pieces, and separating or loosening the fibre, which is effected by a slight alteration of the ordinary cotton or wool machinery." The claim is to the particular positions of the fluted and other rollers in the brake, and the manner in which they receive their motion by a large rotary, vertical spur wheel, "and to the principle of shortening the hurl or fibre of hemp and flax, so as to be carded, drawn, roped and spun, the same as cotton or wool, without restricting myself to any particular form of instruments for effecting the same, as above mentioned."

At p. 252, there is an account of a patent obtained by Messrs. Barnum and Stevenson, for a machine for the same purpose as that of Mr. Tibbitts, in which the rollers are arranged round a large spur wheel, in a way similar to that above described; the claim to novelty, therefore, on this point, is not uncontested. The claim to the "principle of shortening the hurl, or fibre of hemp and flax, so as to be carded," &c. may serve to prove that Mr. Tibbitts is uninformed of what has been done, or rather attempted, both in England and here, in that particular. Considerable sums have been expended upon this project, and the plan has been abandoned, because it was found to be the very reverse of a "useful improvement." Should Mr. Tibbitts succeed in making yarn and cloth from chopped hemp and flax, his claim to the *principle* cannot be sustained, and we apprehend that he will not attempt the *practice*, if he takes the trouble to ascertain what has already been done in this way at Patterson, in New Jersey, and elsewhere.

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2. For a *Machine for Washing Clothes;* William E. Arnold, Hadam, Middlesex county, Connecticut, August 3.

This machine consists of an oblong trough to hold the suds and clothes, and is furnished with the means of squeezing the latter between a piece of timber, which is made to slide backwards and forwards in the middle of the trough, and two other pieces standing near to each end of it. If there is any thing new in it, the inventor

has left the discovery of it to the ingenuity of others, as there is not any claim either to the whole, or to any particular part.

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3. For *Avoiding the Dead Point in the Crank* in the Steam Engine; Valentine Carter, Washington county, District of Columbia, August 3.

This is a new and unimproved edition, of what has been many times patented, essayed, and abandoned. A double rack, formed by teeth within the two sides of an oblong frame, and a pinion with which the racks are alternately to engage and disengage, constitute the *invention*. The claim is to the combination of the whole. A cent for each impression made from engravings of similar contrivances, would be a sufficient fortune for any one whom a lack of roupees would content; and if to this was added the amount which has been expended and lost in attempts to carry the plan into execution, a very comfortable addition would be made to the capital.

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4. For a *Thrashing Machine;* Enoch A. Harman, Upper Marketfield, Bucks county, Pennsylvania, August 5.

"This improvement consists of a vibrating breast, or pitch, formed on, or near, a quarter circle, to be supported by one or more springs on each side, either of wood, or steel, above or beneath the breast, or pitch, or by pullies, or weights."

We have copied *the whole* of the description of the above named machine, and it will be seen that it is without any claim, which happily avoids what appears to us to be a very great difficulty, namely, the discovery of any novelty about it. There is a cylinder, with beaters, a hollow segment of a circle, borne up by springs, and between which and the beaters the grain is to pass; there are also feeding rollers, and a feeding apron, such as are to be found attached to the greater number of its predecessors, many of which ornament the model room of the patent office.

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5. For a machine for the purpose of *Ditching, and Excavating Ground for Canals*, or other purposes; George Henricks, Urbanna, Champaign county, Ohio, August 5.

(See specification.)

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6. For a *Cooking Stove*, called the Double Furnace Cooking Stove; Josiah Richards, Claremont, Sullivan county, New Hampshire, August 5.

This stove is to be made in part of sheet, and in part of wrought iron. In some points it bears a resemblance to A. and J. Barnett's cooking stove, noticed p. 174; the oven, as in that, is below the fire, and the heated air is made to pass under the oven, in its passage to the chimney. There is a contrivance for lessening the furnace part,

by the closing up of two cast-iron plates, and it is from this part, we presume, that it receives the name of "Double Furnace."

There is no claim, either general or particular, and we do not know, therefore, what part is viewed as new by the patentee.

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7. For a *Machine for Breaking Flax, Hemp, and every kind of Textile Plant*, rotted, or unrotted; J. L. F. Roumage, New York, August 6.

We have here another machine for breaking flax, &c. in which the fluted rollers surround, in part, the circumference of a large cog wheel, which causes them to revolve by the gearing of its teeth into the leaves of their pinions; resembling, in this particular, that described by Mr. Tibbitts, (No. 1,) and that of Barnum and Stevenson, p. 252.

A large iron cog wheel, 6 feet in diameter, and having 256 teeth, is made to run vertically, its axis being supported by a strong frame of timber. Two semicircular segments of cast-iron are fastened to the wooden frame; these segments receive 33 pair of fluted rollers, one pair of which are of cast-iron, and the others of hard wood. The gudgeons of these rollers run in boxes, fixed in slots, cast in the segments. The lower roller of each pair has a pinion of 11 leaves on one of its gudgeons, to gear into the large cog wheel. The outer roller of each pair is driven by the motion of the inner. The segments are, of course, of such a size as to admit the cog wheel to stand within one of them, so that it may drive all the pinions. The upper roller of each pair is pressed down upon the lower roller, by means of a steel spring in the form of the letter C; one end of the spring resting upon the box of the upper roller, and the other against the end of the slot in which the box is contained. The larger wheel may be driven in any convenient way. It is proposed to use feeding and receiving aprons, although, it is observed, the feeding and receiving may be done by hand.

There is no claim to any part of the machine.

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8. For an improvement in the mode of *Stiffening Hats;* Jonathan D. Wilson, New York, August 6.

The rim of a hat, and the top of the crown, are to be stiffened in the usual way, whilst the part between is to be left without stiffening of any kind. A piece of buckram, or other stiff substance, is made to fit within the hat, the lower edge tucking under the sweat leather, and the other extending up to the crown. When this is removed, the hat may be flattened down, and put into a trunk, and when replaced, the hat will resume its usual appearance.

The inside stiffener constitutes the claim.

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9. For an improvement in the *Use and Application of Steam;* Timothy Packard and John E. Strong, Granville, Washington county, New York, August 7.

The end proposed, and the novelty claimed by the patentees, is, "the application of steam for the purpose of heating water in tubs, or vessels, for the purposes for which hatters, in their trade and business, usually heat water in boilers and kettles with fire applied under or around them." "By which *invention*, or *discovery*, any number of vessels may be heated in wood, instead of metal vessels, and by one fire for the whole, instead of one fire for each kettle, or vessel," &c. &c.

It is now more than forty years since the first introduction of this mode of heating coppers and vats for dyers, and other purposes; during which period it has been, and still is, very extensively practised: it was, long ago, applied to hatters' kettles in Philadelphia, and probably in other places.

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10. For an improvement in *Book-binding;* Jesse Torry, Germantown, Philadelphia county, Pennsylvania, August 8.

The book is to be sewed to cords or bands, in the usual manner, with the omission of kettle stitches; the bands are not to be inserted in a sawed groove. The book, after being partially sewed, is to be placed in a press, and a strip of leather, from three to five inches in length, glued across the back near to each end, so as just to escape the trimming. A piece of cloth is then to be glued upon the back, sufficiently wide to lap an inch or two upon the lids. When dry, the book is to be trimmed, and again sewed by passing the needle through each signature, near each end, and drawing the thread round the cloth and strip of leather, and over the ends of the leaves, so as to secure them firmly.

The boards are to be protected at the corners and edges by strips of tinned iron, soldered at the corners, and placed either above or under the leather. The leather over the back is left loose, so as to open from the back of the cloth. The binding is to be defended from the attacks of insects, by the mixing of a decoction of tobacco and red cedar, with alum, in the paste.

The claim is to the method of gluing cloth and calf skin upon the back; to the sewing the leaves afterwards to them, so that the thread is passed round on the ends of each leaf; to the attaching the cloth and strips, so glued, to the boards; to the securing the boards by strips of tinned iron; and to the materials mixed with the paste, to protect the binding from insects.

We are not sure that tinned iron has been employed for the purpose proposed; but who has not seen the Bibles, Missals, and other books bound in Germany, double fortified with brass, and sometimes with silver? But, as the present claim is to tin only, brass and silver, we are to conclude, will not interfere. Alum is commonly put into paste, and different materials have been added as a protection against insects; we do not know that the two, above named, have ever been employed, nor are we certain that they are the best which can be found.

11. For improvement in the shears of a *Cloth Shearing Machine;* Samuel A. Britt, Cazenovia, Madison county, New York, August 10th.

A cylinder, three or more feet in length, and about three inches in diameter, is surrounded by four blades of steel, which are bent so as to make a quarter of a circle round the cylinder. These blades, or cutters, are each sustained upon springs. The cutters in their revolution pass, and act against, a stationary blade or cutter, performing the operation like ordinary shears.

There is not any thing claimed in this invention, and the whole so strongly resembles several other patented machines, as to leave us at a fault in the attempt to discover where the improvement lies. The drawing is without references.

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12. For a *Cooking Furnace Gridiron;* Jonathan Powers, Lansingburg, Rensselaer county, New York, August 10.

The following is the specification:—

"The Gridiron is in a circular form, and concavo-convex; the ribs or bars of which, on the upper side, have a concave upper surface for collecting the gravy, and conveying it downwards to the gravy trough, which stands all around, on the outer edge, having its spout on one side for discharging the gravy. There is a handle on one side."

"It may be made of cast-iron, or wrought, or sheet-iron, or any other material, and may be varied in form, size, or shape, as convenience may require, with, or without legs, for so I make them.

"Jonathan Powers."

We are again at a loss to know what is intended to be patented. It certainly cannot be a round gridiron, as these have been made by the thousand. The fluted, or concave bars, and gravy trough, we have known for upwards of forty years: these, therefore, are not new. But, as the patentee has not chosen to tell his claim, it is not our business to do so; we therefore leave the discovery to others.

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13. For *Preserving Apples and other fruit,* Beets, and Sweet Potatoes, and other roots; Amos Hart, Wharton, Fayette county, Pennsylvania, August 10.

The mode proposed is to pack the fruit, or roots, in dry pulverized charcoal, contained in well seasoned wooden vessels.

The use of charcoal in preserving animal matter, and in destroying the putrescent odour and taste of the most filthy water, is well known, and we have no doubt that the same article will tend to preserve vegetables from decay. We apprehend, however, that the soiling effect of fine charcoal dust, will prevent its extensive use, excepting, it may be, in packing fruits, &c. for exportation.

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14. For a Compound *Lever Press for Pressing Cotton;* Philenzo Payne, Claiborne county, Mississippi, August 10.

We will hereafter give an engraving of this press, with a description, or specification.

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15. For *Raising the Nap on Woollen Cloth;* Zachariah Allen, Providence, Rhode Island, August 10.

The improvements in the machinery for raising the nap upon cloth, consist, first, of what is, by the patentee, denominated combs, two of which are made to act, with reversed movements; one being placed at each end of a roller over which the cloth passes, preparatory to its being operated upon by the teasles, or cards. The intention of the combs, and of two rods attached to them, is, to draw the cloth, widthwise, thereby removing all wrinkles, or folds, which would prevent its being acted upon equally in every part; secondly, in a contrivance for laying the cloth in regular folds, after it has passed the teasles, in order that it may be ready for the same operation, and rise free and disentangled, for this purpose. These are the two points claimed. The exact mode pursued would require drawings for its explanation.

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16. For a machine for scattering manure, called a *Manuring Wagon;* James Bowman, Beaufort, South Carolina, August 12. See page 277.

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17. For a *Machine for Spinning Wool,* for the use of families and manufacturing establishments; Warren Allen, New Haven, Oswego county, New York, August 15.

The description of this machine, is of considerable length, but appears to us to be laboured and involved, whilst the drawings which accompany it, lend but little aid in understanding its construction. The machine, like most of the *family spinners,* seems to possess but little novelty; there are many such instruments, but they are generally only epitomes of those of a larger kind.

There is no claim whatever, and, of course, the whole machine must be new, or the patent of no value.

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18. For an instrument for *Sharpening Knives,* and other cutting instruments made of iron, or steel, called "Dunn's knife-sharpener;" William J. Dunn, New York, August 18.

This, in its mode of operation, is very similar to some instruments for a like purpose, which we have already described; (see p. 398, of the last vol.) Two steel plates are prepared by having teeth cut into them similar to saw teeth: they, however, differ from saw teeth in being varied in size, the angle at the bottom being made more acute, as you proceed from one end towards the other. The two plates are notched alike, and are to be placed upon each other, and retained in their situations by a screw, or screws. The plates may be about two inches in length, and when fixed in a handle, or stand, for use, the teeth of the two are not allowed exactly to coincide, the

plates being slid a little, endwise, the angle at the bottom of each notch is then formed by the two plates conjointly; and by altering the lapping, a new sharpening angle is obtained. The claim is for "forming the teeth of two, or more sizes and widths, so as to adapt it to the sharpening of knives, and other instruments of different sizes, more effectually; and with two, or more, steel plates."

The same end has been attained in one of the English instruments above alluded to, and also in some made in this country. The defect of instruments of this kind, where but two plates are used, is, that the knife, in being sharpened, has its hollows, or indentations, rather increased than corrected, whilst the number of bearings employed in Westby's, and other sharpeners, straightens, as well as sharpens the edge. The mode of altering the angle in the sharpeners may be seen in the wood cut of Westby's.

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19. For an improvement in the business of *Ferrying and Draying;* Lunenberg C. Abernathy, Boone county, Kentucky, August 18.

A paddle wheel, like that of a steam boat, is to be placed on one side of a river, and is to be driven by the current. The shaft of this wheel carries two cog wheels, which may alternately be made to engage in a wallower, and turn it in opposite directions. On the same shaft with the wallower there are two drums, to each of which, one end of a rope is to be fastened, and around each a portion of it is to be coiled; this rope is also to extend, double, across the river, and pass round a pulley on its bank. To the middle of this rope the ferry-boat is to be attached, when it may be sent over, and returned by a man who attends the wheel, and engages and disengages the wallower.

The same apparatus is to be attached to a dray, or other carriage, to draw goods from or to a warehouse, near the banks of the river. The whole plan, we suppose, being considered as new, no particular claim is made.

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20. For an improvement in the *mode of Cutting Garments;* Otis Madison, Troy, New York, August 18.

A flat ruler, something like a Gunter's scale, is to be divided in a way designated in the specification and drawing, furnished by the patentee. The measurements taken are to be marked down upon a piece of slate, or slate paper, let into, or otherwise attached to the 'Mathematical Ruler.'

The claim is to the mode of arranging the divisions, or measures, and the attaching the slate, or slate paper, to the ruler.

It is acknowledged by all the amateurs in the art of Cutting Garments, that the scales, which within a few years have come into general use, have introduced a degree of system and certainty into that business which were previously unknown. There are a number of patented instruments, invented by different professors of the art; we are compelled, however, to tread lightly upon the ground which

they have occupied, or we should soon manifest our want of skill; our learning not enabling us to explore it with advantage to others, or safety to ourselves.

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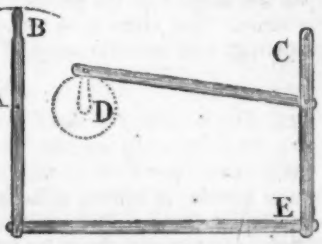
21. For a *Portable Trip Hammer;* Samuel Kilburn, Sterling, Worcester county, Massachusetts, August 18.

A fly wheel is to be turned by a crank, having upon the axis a cam wheel, with five teeth, or lifts, which are to operate upon the handle of the hammer. This machine is intended to be turned by hand, the hammer to weigh from 20 to 50 lb. and the fly wheel from 150 to 250. The part in which the merit of the machine is supposed to consist, is a combination of levers for giving motion to the crank, instead of turning it directly by hand. There are four of these levers, the first of which is moved backward and forward by hand, whilst the last of the series acts as a pitman, one end of it being attached to the crank. The claim of the patentee is to this combination of the levers, which he thinks will produce a great mechanical advantage. The sketch in the margin will serve to show the arrangement proposed. The first lever works on a fulcrum at A, being acted upon by the handle at B; the third lever has its fulcrum at C, the fourth, or pitman, being attached to the crank D. As to any mechanical advantage to be obtained by a combination of levers, where time and power are both taken into the account, it is a nullity. We, at one time, thought that the vibrating motion of B, might be less fatiguing than the turning of the common crank, and many years ago fixed a lever to turn the large wheel of a lathe upon this principle. Suppose the lever C, E, in the above sketch, to turn upon a fulcrum at E, the handle being at C, with the pitman and crank D, just as shown above, and our whole arrangement will be understood. It was kept in use for a considerable length of time, and those who worked it were undetermined in their opinions as respected its advantage over the crank. We mention this, because we think that the only possible benefit of Mr. Kilburn's levers, must be afforded by the application of the power of a man in a better manner than that usually followed; but even this, according to our experience, is doubtful.



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22. For an improvement in the making or manufacturing of *Blanks for Checks, or Drafts,* or Bills of Exchange; James Atwater, New Haven, Connecticut, August 18.

On the 11th of June last, a patent was granted to James Atwater, Nathaniel Jocelyn, and Simeon S. Jocelyn, for the purpose indicated in the title of the present patent. An improvement upon that plan has been made by Mr. Atwater, and for this improvement a patent

has issued. The interest of the patentee forbids the publication of his specification, at present.

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23. For an improvement in the *Wheat Fan;* George Hoffman, Frederick county, Maryland, August 21.

The general form of this fan is the same as those in common use, but it differs in a variety of particulars, which it would be difficult, if not impracticable, to explain without a drawing. The mode of communicating motion to some of the parts, the wind-wheel and the riddles, offer certain peculiarities, which are described and claimed by the patentee.

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24. For preparing or *Manufacturing Dye by Steam;* Reuben Wood, Erin, Tioga county, New York, August 25.

We have, in our remarks on the patent of Messrs. Packard and Strong, (No. 9,) anticipated all which it might be necessary to say upon the subject of the present patent, as the plans are essentially the same. The claim is to "the application of steam to the making, preparing, and manufacturing of dyes."

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25. For an *Air Furnace Oven Stove;* Oliver Davison, Johnstown, Montgomery county, New York, August 25.

We cannot perceive in this stove any thing materially different from a number of others, although it varies from them in the form of some of its parts. The patentee has merely described the whole, without making any claim, or telling in what his invention consists, and as we are unable to do so for him, we dismiss it without further remark.

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26. For a machine for *Packing Cotton;* Obadiah Stith, Laurenceville, Brunswick county, Virginia, August 25.

Each cheek of this press consists of two bars of iron standing upright. They are framed into a bed piece, and stand at the distance of a few inches apart, to allow a piece, called a driver, to extend out between them. These iron bars are perforated with round holes, to receive pins which serve as fulcra, upon which the levers work which are to force the driver and follower down upon the cotton. The cheeks are placed apart at a distance equal to the length of the bale to be packed. The levers, of which there are two, are each twenty feet long; they have a mortise in the middle, to allow them to pass up and down on the iron cheeks at each end of the press. The levers are to be drawn down at each end, alternately, the pins placed in the holes of the bars being shifted as they descend. The sides of the press are boxed up to receive the cotton, which is put in at the top. When the levers are at the upper end of the cheeks, the driver falls on one side, and offers no obstruction to the introduction of the cotton. An iron strap, or stirrup, from each end of the driver, con-

nects it with the levers, descending into the centre of the mortises, where it is secured by strong pins, upon which it works as a joint.

We shall probably recur again to this press, as it is certainly more simple than many of those which are used for the same purpose, and we think that it will be found convenient in practice; should this appear to be the fact, an engraving shall, hereafter, be given, for the purpose of making it better known.

The general construction of the press is claimed, as is the particular mode in which the levers are made to operate; the iron cheeks with the slot between the bars which compose them, and which allow the driver to be drawn down by the levers; the application of the stirrup and driver, are also claimed.

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27. For a machine for *Raising Water by Atmospheric Pressure;* Samuel M'Cune, Wilmington, Clinton county, Ohio, August 25.

Captain Savary's engine, was, in its day, a thing of great merit, but its reinvention will scarcely confer immortality upon any one of the numerous candidates for that honour. The present patentee appears sensible, however, that there is nothing new in the principle of the engine which he has patented, as he says "it is expressly to be understood, that what I claim as new, is, the mechanical application of the above." We must not, therefore, place him in the class of those who have simplified the steam engine, by restoring it to the state in which it existed a hundred and thirty years ago, as he merely proposes to open and close his valves, introduce his jets, and perform some other requisite operations, by an arrangement of parts somewhat different from that formerly pursued. There are to be two cisterns, which are alternately to be filled with steam, in order to its being condensed by jets of cold water; they are then to be filled with water by the pressure of the atmosphere upon that contained in a reservoir below, into which pipes, furnished with valves, pass from the receivers, or cisterns. The water is to be let out from these upon a water wheel, and from the shaft of this wheel the motion is derived which is necessary to the introducing the condensing water, to the opening and closing of the valves, and for other purposes. We do not think it necessary to describe the manner of doing these things, as there does not appear to us to be any particular merit in them. And when it is recollected that the cylinder and piston engine has long since superseded the use of captain Savary's, even where the only operation to be performed is the raising of water, no one versed in the history of mechanical inventions would believe that it was any great improvement to use the latter in turning a mill.

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28. For an improvement in *Canal Boats;* Thomas W. Bakewell, Cincinnati, Ohio, August 25.

The object proposed to be accomplished in the improved canal boat, is, to fix an awning above the roof, or top, of the cabin, which awning may be lowered to admit of passing under a bridge. A

patent for a contrivance for the same purpose was granted to Jacob Bromwell, of Cincinnati, on the 23d of June last, and is noticed at p. 190. The support of the roof, or awning, as described by the present patentee, is to be constructed of light pieces of timber, so framed and jointed, that they may double down upon the permanent roof, upon the principle which regulates the approach of the two sides of a parallel ruler, as will be seen by the claim, which is "the application to canal boats of the forementioned principle, which principle is that on which the parallel ruler is made, and by which a rectangled parallelogram may become a rhomboid, and vice versa, the sides remaining unchanged."

It is proposed, as in Bromwell's patent, to render the awning self-acting, by a projecting piece, properly fixed, to strike against the bridge, and press the framing down; it may also be made to rise spontaneously by a weight acting over a pulley, or by other means.

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29. For an improvement in the *Grist Mill;* Job Wickersham and Thomas Crozier, Fairfield, Columbiana county, Ohio, August 25.

This is another contribution to the number of grist mills which have been proposed for family use. It possesses, and, in fact, lays claim to, but little novelty. The lower stone is to be the runner, and is to be 16 inches in diameter. The upper, or stationary stone, is square, and measures 18 inches on the side; it is perforated to allow of feeding. The runner is fixed permanently on the spindle. The claim is to "the runner being permanent on the spindle, and the arrangement of the boxing, by which we are enabled to make it tight below, and prevent all waste of meal."

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30. For manufacturing *Felt for Cloth, Padding, Carpets, &c.;* John Barker, Bridgwater, Oneida county, and Leonard Kinsley, Catskill, New York, August 25.

The machinery to be used, and the manner of procedure, are similar to what has been already described in several preceding patents, having the same object.

There is to be a carding machine, to deliver the wool in a continued sheet.

A long table, or frame, with an endless apron, on rollers.

A portion of the web, or batt, is to be cut, or torn, and placed crosswise upon the apron, and the operation continued until the wool is sufficiently thick for felting.

"What we claim as our invention, of the above described machine, is, the construction and application of all, except the carding machine."

Specification of a patent for some improvements in the boilers of Steam Engines. Granted to Anthony Hermange, *Baltimore, Maryland, November 26th,* 1828.

To give a sufficient description of my improvements in steam boilers, it will not be necessary to enter into an account of steam boilers now in use; as they are, of course, very various, and well enough known, to distinguish them from my modes of construction. The boiler itself, with regard to its outward contour, I will make of any convenient shape. As convenient a one as any, will be to have it of a cylindrical form, or of that of a parallelopiped; or this last surmounted by a half cylinder; or of a prism, whose base is a hexagon; of a cubical, or indeed of a variety of forms. I will place the fire-place, and flue, and fuel-pipe, (where I have one especially for that purpose, particularly when the fuel to be used is coal) inside of the boiler, disposing of them in such a manner, that when the proper quantity of water shall be in the boiler, they shall be below its surface. This will secure the advantage of having the water almost entirely to surround the fire-place, flue and fuel-pipe, where this last is employed. The flue, particularly, shall be lengthened out inside of the boiler, in a variety of ways, in order that it should present an extensive surface in contact with the water, and that the heat evolved in the fire-place, should thus, by means of the heated air freely circulating through the lengthened flue, be all, or nearly all, communicated to the water before the flue passes out of the boiler. The flue will, in this manner, have an effect somewhat analogous to that of a reverberatory furnace. I said the flue may be lengthened out in a variety of ways; it may, for example, go from the fire-place perpendicularly upwards for some way, then form an arch, and return vertically downwards, and have its exit from a convenient place in the lower part of the boiler, or thereabouts; this would be one of the simplest methods. After ascending as before, the flue may have a tortuous, or spiral, disposition downwards, and have also its exit as before.—The main flue may also, above, be divided into two, three, four, or more, smaller flues, as convenience may dictate, and these again may be connected together in the bottom part of the boiler, or towards the bottom, for their exit from the boiler, by a single flue or more; from the fire-place, the flue may have a serpentine form in the boiler, and have its exit at any convenient place. In fact, it will readily be perceived that a variety of modes may be adopted. The fire-place I will construct of any convenient form, and place it in any position that the easy introduction of fuel, or any other such circumstance, shall require. It may, for instance, be placed at the bottom of the boiler, with a grate opening into a wind-box below the boiler; in this way, the fuel-pipe may communicate from the side of the boiler, at an angle from the horizon, sufficiently inclined to permit the fuel to fall with facility into the fire-place. This would be an excellent disposition, when the fuel to be used is coal; a coal-receiver, with two

sliders, or doors, may thus be adapted to the outside end of the fuel-pipe, in order that, at the instant of supplying fuel to the fire, the heated air in the fuel-pipe may not be suffered to escape. When the fuel is to consist of wood, it would, no doubt, be better to have the fire-place opening, for the reception of the wood, on the side of the boiler, or the end of it, by means of a door a little above the bottom of it; so that the water may also come in contact with the bottom of the fire-place. In this way, also, there may be practised, if convenience requires it, an opening through the bottom of the fire-place, (across which, a grate may be placed, through which the ashes may drop) communicating with an opening through the bottom of the boiler, which may there have a wind, or blast, box, attached to it. It will be perceived that the arrangement may be various. As in the combustion of the fuel, with regard to boilers in common use, much of its inflammable substance passes off in the form of dense smoke, &c. without entering into a perfect state of combustion, I will employ bellows (conveniently adapted for the purpose, and which may, of course, be worked by the engine itself) for the purpose of keeping up a constant current of atmospheric air through the ignited fuel, and to keep up the current of air, thus heated, throughout the course of the flue. As the air, in approaching towards the exit of the flue, from the boiler, will become cooler, and, of course, from its increased density be of less volume, it will be well, ordinarily, to diminish the flue, gradually, as it approaches its exit. I will avoid bringing the fuel-pipe (where one is used,) or the flue, into that part of the boiler occupied by steam, for the following reason: the fuel-pipe and flue, having a direct communication with the fire-place, would, of course, always be filled with air intensely heated, which would be extremely likely to keep them in a red hot state; in this condition, being in contact with steam, a constant decomposition of portions of the steam would take place; its oxygen combining with the metal, would rapidly corrode it, to the evident danger, after a little use, of the bursting of the boiler; whilst hydrogen gas would be extricated, during the progress of decomposition, which might interrupt the free and secure motion of the rest of the machinery of the engine. For the purpose of ascertaining, always, the height of the water in the boiler, I will make use of any description of water-gauge that may be adapted to ordinary steam-boilers: a very good one will be to have two short pipes accurately inserted into the boiler; one, into that part occupied by the water, and the other into that containing the steam; and the communication with both formed on the outside of the boiler, by means of a strong glass tube; in this way, the height of water may always be determined by sight. A stop-cock may be used; but will not, of course, be so convenient as the water-gauge above. It would be well to have the steam-pipe going off from, or near, the most elevated part of the boiler; this will be a matter of convenience. For supplying the boiler with water, I will make use of any of the ordinary means. The pump for the supply of water may be so managed as to have, at will, a longer or shorter stroke, according to the demand of the boiler for water. In the construction

of these improvements, I will employ any description of metal in common use for steam-boilers; but I need not add, that copper would be the best. The blast-box, where one is used, will, of course, vary in its structure, according to the most suitable adaptation to the boiler, as well as the bellows employed. The wind-pipe of the bellows may either be adapted to a blast-box, or may be moveable, so as to pass through a hole made in the door of the fire-place, (where there is a door) or permanently fixed under the door, or at its side, or indeed in any other convenient situation. As for the fastenings, or other modes of adapting the several parts of the boiler, &c. together, I need hardly mention that I will adopt any convenient modes now in common practice in similar cases.

After the exit of the flue from the boiler, it may, if thought proper, be carried through the water tank, or vessel, destined to keep up the supply for the boiler, for the purpose of heating it before it is pumped into the boiler. No doubt, most of the principles laid down in the preceding descriptions, have, taken separately, been heretofore known; but I claim as my own, the combinations of principles therein stated. ANTHONY HERMANGE.

DESCRIPTION OF THE DRAWINGS—PLATE 4.

Fig. 1, is a vertical section, showing the internal structure of the boiler, &c. The fuel fitted for a boiler made in this way would be coal.

a, the fire-place.

b, the grate.

c, the blast-box, with a slide, or door, at the bottom.

d, the wind-pipe of the bellows.

e, the fuel-pipe.

f, a sliding door, shutting the fuel-pipe, and when opened, permitting fuel to drop down from the fuel-receiver.

g, another sliding door, stopping the communication from the open air, when the slide *f*, is open.

h, the fuel-receiver, or box.

i, *i*, *i*, space of the boiler occupied by the water.

k, space of the boiler filled with steam.

l, steam-pipe.

m, water-gauge.

n, *n*, *n*, flue-pipes: there may be four, more or less, passing down through the bottom of the boiler, and ending in a single larger flue-pipe.

Fig. 2, represents the bottom of the boiler, pierced by the flue-pipes *n*, *n*, &c.—*b* is the grate at the bottom of the fire-place.

n', is a larger flue, forming the exit from a flue, or heat-box, below the boiler; *n*, *n*, open into this flue-box, after having pierced through the bottom of the boiler.

Fig. 3, represents *n*, *n*, passing into flue-pipes, instead of passing from the boiler into a flue-box below. These flue-pipes *p*, *p*, communicate with *n'*; they might, if convenient, be placed under the boiler.

Fig. 4, is a middle section of a boiler in the form of a parallelopiped, surmounted by a half cylinder. This is an excellent mode when the fuel is wood. When similar letters to those in Fig. 1, are used, they represent portions of the boiler, &c., intended for similar purposes. The dotted additions to the figure (*b*, *c*, *d*,) show how a grate, wind-box, and the wind-pipe of the bellows may be adopted.

o, is the door of the fire-place.

Specification of a patent for a machine for Ditching, or Excavating Ground for Canals, or other purposes. Granted to GEORGE HENRICKS, *Urbanna, Champaign county, Ohio, August 5*, 1829.

I MAKE a carriage, or frame, with four wheels, the front wheels being made and fixed in all respects like those of a common wagon. Under the body of the carriage, a plough, with the mould board, of any of the known forms, is fixed so as to extend along between the hind and fore wheels, the land-side of the plough standing in a line with the centre of the bed of the carriage, or frame, so that the mould board may reach nearly to one side; it is also to be depressed sufficiently below the wheels to turn up the required quantity of earth. In order to remove the earth as it is turned up by the plough, there are a number of elevators, or boxes, made usually of strong sheet iron, somewhat in the manner of the elevators of a flour mill, but much larger. These elevators are attached to each other, so as to form an endless band, or chain, the boxes being connected to each other by means of strong links. These elevators are made to revolve by passing them round two revolving shafts, or rollers, one of which is fixed as near to the mould board of the plough, as will allow the elevators to pass round: this stands longitudinally with the carriage and plough. The other roller is fixed by proper frame work above, and extending to a distance beyond the side of the carriage. When this chain of elevators is made to revolve as the carriage is drawn forward by horses, or oxen, the earth which is ploughed up is received into the elevators, is by them raised and carried beyond the side of the ditch, so as to be delivered, or thrown upon the bank, or it may be thrown into carts, or on to stageing, in the digging of canals.

In order to cause the shafts to revolve, upon which the excavators are sustained, the lower of these shafts is geared to one of the hind wheels, from which teeth, or cogs, project inwards, so as to take into teeth, or cogs, which form a trundle upon the end of the shaft; the planes of these wheels, or trundles, standing at right angles with each other. The shaft I generally make square, so that the flat sides of the elevators may exactly fit them on each face, as they revolve. If made round, spikes must project from them in such a way as to check the elevators, and prevent their slipping round.

In order to insure the turning of that wheel of the carriage to which the shaft is geared, its periphery, or rim, has a number of projecting

HERMANGES BOILERS

Fig. 1.

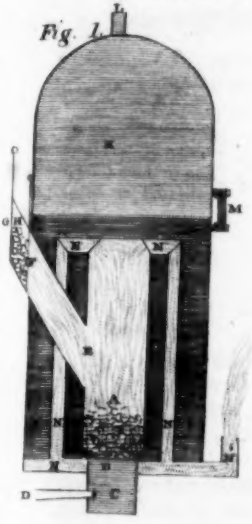


Fig. 3

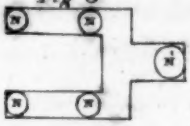


Fig. 4.

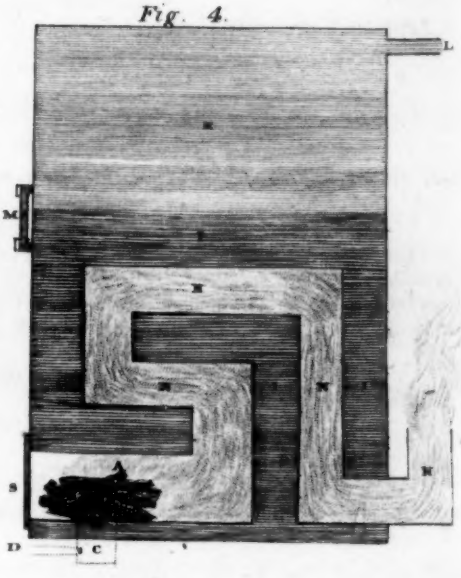
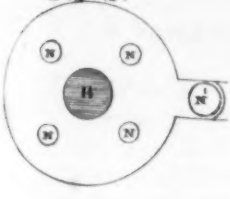


Fig. 2.



Walker's Refregerators

Fig. 1.

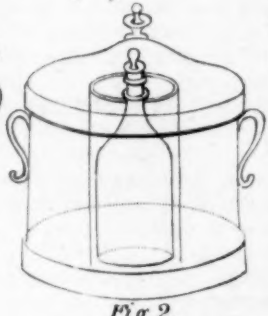


Fig. 2.

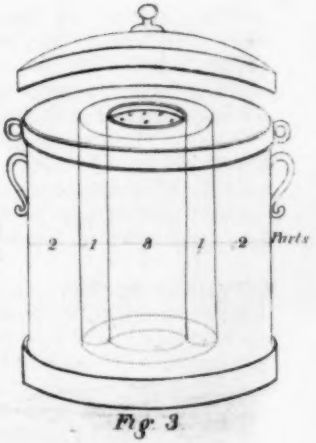
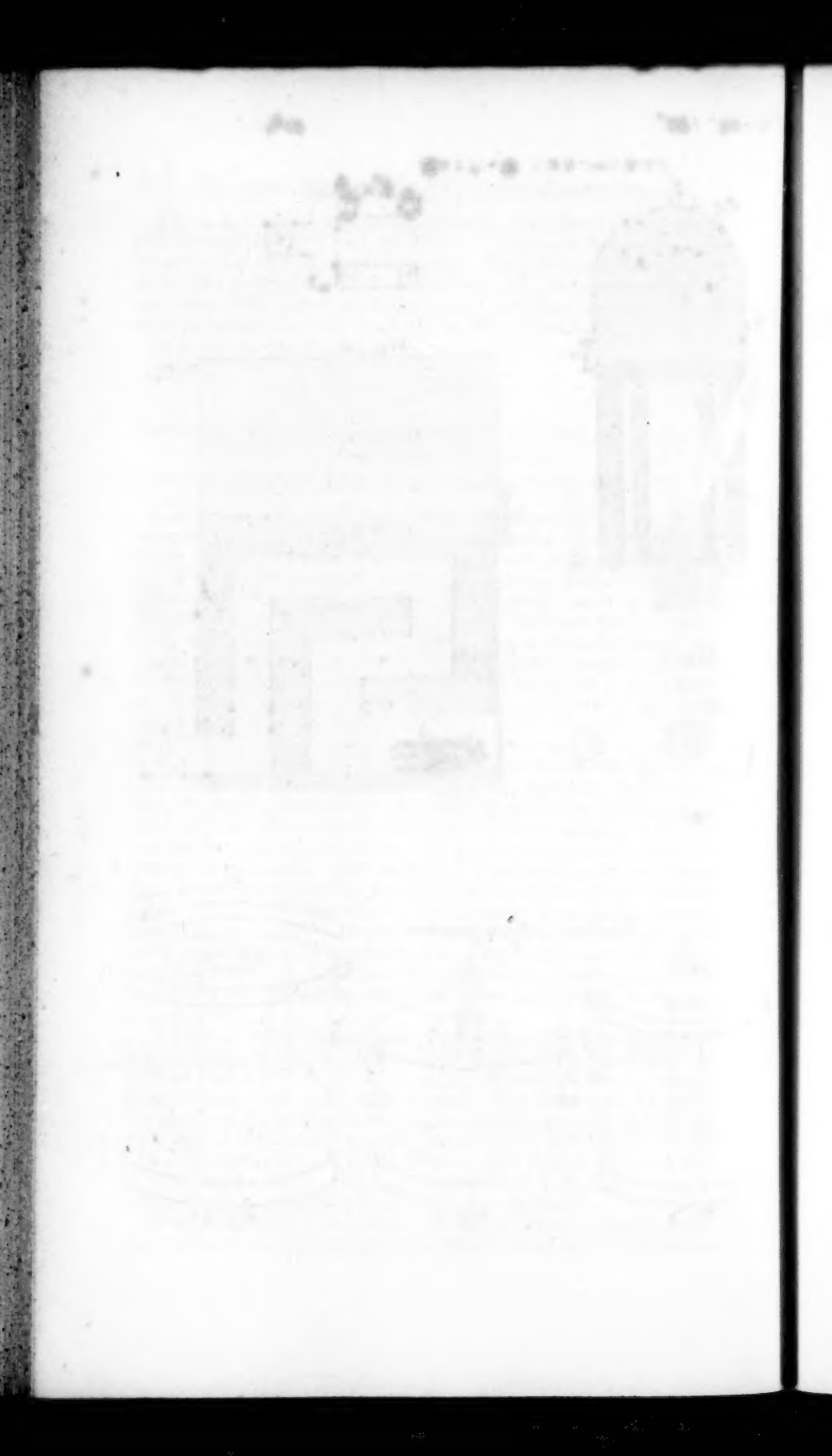


Fig. 3.



spikes of iron, to lay hold of the ground; as, without these, it would slide, instead of turning.

What I claim as new in the above described machine, is, the use of the elevators, plough, rollers, and gearing, in the manner described. And I do hereby declare that the foregoing is a full and clear description of my said machine.

GEORGE HENRICKS.

FRANKLIN INSTITUTE.

Quarterly Meeting.

THE twenty-third Quarterly Meeting of the Franklin Institute, was held at their Hall, October 15, 1829.

ISAIAH LUKENS, Vice President, in the Chair.

The minutes of the last Quarterly Meeting were read and approved.

The annexed quarterly report of the Board of Managers, accompanied by the quarterly report of the Treasurer, was presented and read; when, on motion, it was accepted, and referred to the committee on Publications.

On motion, adjourned.

ISAIAH LUKENS, *Vice President.*

A. S. ROBERTS, *Recording Secretary.*

The twenty-third Quarterly Report of the Managers of the Franklin Institute of the State of Pennsylvania, for the Promotion of the Mechanic Arts.

THE Board of Managers, in obedience to the 3d section of the 10th article of the constitution, make report of their proceedings since the last quarterly meeting of the Institute.

The principal objects which have engaged the attention of the board during the preceding quarter, are the experiments "to ascertain the value of water as a moving power, and the relative effects produced by it on water-wheels of different constructions," and the monthly meetings for the discussion of scientific questions, upon the plan adopted at the quarterly meeting in April last.

The committee appointed to carry into effect the views of the board on the subject of water power, have continued to be actively engaged in the prosecution of the undertaking, and by their zealous and praiseworthy perseverance, have succeeded in collecting about $2,000 to defray the expenses.

The house for the accommodation of the apparatus for making the experiments, situated at the corner of Ninth and Vine streets, is completed. Four mill-wrights are now at work; and it is confidently expected that the committee will be able to present to the Institute the result of their labours at the next annual meeting. An additional subscription is considered necessary to enable the committee to complete the experiments, which, it it is hoped, the members of the Institute will voluntarily contribute to an object of so much utility.

The monthly meetings have been regularly held, and the subjects proposed have been discussed in that liberal and amicable spirit which ought always to characterize the search after truth. It is believed that something has already been done to forward the great work of improvement, for the promotion of which this association was formed.

A more general attendance of the members is desirable, and would tend to increase the interest already excited at these meetings, and render them still more useful.

The Committee on Inventions have diligently attended to the objects submitted to their inspection, which have been more numerous than formerly. The utility of this Committee is beginning to be generally felt and acknowledged by inventors, and they are frequently put in possession of facts and principles in relation to their supposed inventions, of which they were previously ignorant, and by which their views and pursuits are entirely changed. Thus, often an honest and industrious mechanic, with mistaken ideas, is saved from the loss of time and money, while the ingenious inventor is encouraged and assisted by the countenance and concurrent opinions of those more experienced than himself, and thereby enabled to reap the reward of his exertions, at the same time that an important improvement is ultimately secured to the public.

The Board of Managers also beg leave to announce that the vacancy in the Professorship of Mechanics and Natural Philosophy, occasioned by the resignation of Dr. T. P. Jones, has been filled by the election to that office of Walter R. Johnson, A. M.

The lectures for the season, will commence on the second Monday in November, and it is hoped that the members of the Institute will evince by their attendance, that interest in them which the variety and the utility of the subjects to be treated of would seem naturally to excite.

The Board have always viewed the lectures of the Institute, as one of its most useful auxiliaries in the diffusion of practical and scientific instruction through the community, and also as one of the most effectual means of increasing the prosperity of the institution, and, therefore, respectfully ask the members of the Institute to aid and assist by their exertions, in extending the sphere of their usefulness.

The Board announce, also, that Mr. S. C. Walker has resigned the office of Teacher of the Mathematical School of the Institute, which he has conducted in a creditable and satisfactory manner.—The vacancy thus created, has been filled by the appointment of Levi Fletcher, A. M., a gentleman already known to the Institute as their first teacher of Mathematics, from which situation he was compelled to withdraw, in consequence of ill health.

From the additional experience Mr. F. has acquired in the practical applications of the science of Mathematics, by being employed several years on board one of our ships of war, the board feel every confidence in his ability to communicate instruction in that department. The school will be opened the 27th inst.

The Drawing School will be opened at the same time, under the direction of the former teachers, Mr. H. Bridport and Mr. G. Strickland. The Board recommend strongly to the members these evening schools, as of very great importance to the rising generation, connected as they are with the privilege of attendance on the lectures. An opportunity is thus offered of acquiring useful knowledge, at a much cheaper rate than it can be obtained in any other manner, and at the same time of keeping the youths who attend, away from the haunts of idleness, immorality, and vice, and nourishing in them, at an early period of life, a taste for the solid pleasures which the study of the arts and sciences must always afford.

The quarterly report of the treasurer is herewith presented, from which it will be discovered that the general funds of the Institute are very limited, owing to the tardiness of many of the members in the payment of their dues. The Board take this opportunity of urging punctuality, as the only means by which this association can be rendered beneficial to its members and the public. The funds appropriated to meet the current expenses are at present considerably deficient of the amount due by the Institute, and as the expenditures have been limited by the Board to the least possible sum, to keep them within the receipts, they have been compelled to postpone the execution of several important designs for want of means. If each individual member would use a moderate exertion for the interest of the society, it would be enabled not only to liquidate every debt, but would also have ample means to carry all the views of the Board into effect.

The sinking fund derives from the rents of the building, and from other sources, an income sufficient to pay the interest on the Loan, and leave an annual surplus, which will in a few years reduce the debt to a very moderate sum.

A number of valuable additions were made to the Library and Cabinet of Models and Minerals during the last quarter. The board are happy in being able to state that the Hall of the Institute is becoming more and more attractive to the public. The number of models of machines recently deposited, and the valuable collections of minerals, books, and periodicals, now belonging to the Institute, are very interesting to strangers, as well as citizens. The rooms are open every day, Sunday excepted, and may be resorted to with profit and satisfaction, the Actuary being constantly in attendance, using every exertion in his power to gratify the curiosity of visiters. Respectfully submitted.

THOMAS FLETCHER, *Chairman, P. T.*
WM. HAMILTON, *Actuary.*
Hall of the Franklin Institute, Oct. 15, 1829.

Monthly Meetings.

The Stated Monthly Meeting of the Institute was held at their Hall, on Thursday evening, October 22nd.

THOMAS FLETCHER, Vice President, in the chair.

The minutes of the last monthly meeting were read and approved.

The following donations were presented to the Institute, viz:—The Architecture of André Palladio, containing the antiquities of Rome, accompanied with notes and remarks, by Inigo Jones; and Addresses, by John D. Godman, M. D.; both presented by J. K. Mitchell, M. D. Gallaway's History of Steam Engines, from their origin to the present time; presented by Professor Franklin Bache. Remarks on the Legal Provisions for Education in Pennsylvania, by W. R. Johnson, A. M.; and an Introduction to the Greek Language, with a Key; by the same; both presented by the author. Judge Story's Inaugural Address; presented by Hilliard, Gray & Co. A specimen of native Gold, from North Carolina; a specimen of native Silver, from Mexico; and a specimen of Emerald; presented by Thomas Fletcher. A Galvanic Apparatus; presented by Robert T. Knight.

The Corresponding Secretary also laid on the table the following Mechanical and Scientific Journals, received in exchange for the Journal of the Institute:—*London Journal of Arts and Sciences* for September; *London Register of Arts and Journal of Patent Inventions* for September; *Gill's Technological and Microscopic Repository* for September; *Annales de Chimie et de Physique* for May and June; *Bulletin de la Société D'Encouragement pour L'Industrie Nationale* for May and June; *Journal des Connoissance Usuelles et Pratiques* for July; *Bibliothéque Physico-economique* for July; *Journal Universal des Sciences Medicale* for June.

The discussions for the evening being called for, the following papers were presented, viz. a reply to the query, "what is the relation between rolling and dragging friction?" by W. R. Johnson. A reply to the query, "which will move down an inclined plane with the greatest velocity, a wheel of two, or one of four feet in diameter, supposing their weight to be the same, and the matters of each to be all disposed around its periphery?" by Mr. Lloyd Mifflin, and another on the same subject, by Mr. Charles Potts. Mr. Potts also presented a paper in reply to the query, "what is the absolute centrifugal force of a body revolving in a circle of a given diameter, d, with a given velocity, v?" A reply to the query, "does a body descending on an inclined plane with an accelerated motion, press the plane with the same force through every portion of its length?" by Mr. David H. Mason.

The above papers were severally read and discussed, when, on motion, they were referred to the committee on publications.

On motion, the query, "what is the true mode of computing the power of high pressure steam engines?" was selected as the subject of discussion at the next meeting.

(Extract from the minutes.)

THOMAS FLETCHER, *Vice President.*

A. S. ROBERTS, *Recording Secretary.*

On the use of Alumina with Pigments designed for the Pallet. By A. A. Hayes, *Roxbury Laboratory.*

In preparing his paints, by levigating pigments with oil, the artist is often perplexed by the diversities which they exhibit after this operation. Some pigments present a chemical combination with the oil, while others can be suspended in it only by considerable labour, and soon separate when left at rest. These differences can be rendered of trifling importance, by employing such a substance as will retain those compounds which possess no attraction for the oil, in a state of uniform suspension, and whose action will be in some respects analogous to that of the gum used in inks and water colours. The property which the hydrate, or carbonate, of alumina possesses, of mixing freely with oil so as to form a transparent, consistent, and almost colourless compound, admirably fits it for this purpose. At the request of Mr. Rembrandt Peale, I prepared some pigments by mixing them with alumina while moist. When ground with oil, he found them to possess all the most valuable properties of the best colours. The tendency to separate from the oil, and the disagreeable property, which some colours possess, of becoming more fluid when an attempt to preserve them is made by immersing the pallet in water, disappear, after they have been ground with a small portion of alumina. The artist has it in his power, thus, to increase or diminish the fluidity of his paints, and to render them uniform.—Some pigments become valuable as glazing colours, as the Prussiate of copper, (Hatchette's Brown.) Vermilion and Naples Yellow, acquire new properties.

For printing from blocks, as in the manufacture of ornamental floor-cloths, it is often desirable to increase the fluidity of the paint, so as to prevent the dropping of small thread-like parts on the work, without causing it to spread. This may be accomplished, by adding a small quantity of whiting to the pigment while grinding; the artisan can then load his blocks with paint, and consequently give a thick coating to the print. [*Silliman's Journal.*

On a fine Scarlet Pigment for the Pallet. By the same.

While prosecuting some experiments on the pigments employed by artists, I prepared a quantity of the bi-iodide of mercury, and gave it to Mr. R. Peale, requesting him to make some experiments on its working properties and permanency. This distinguished artist obligingly commenced them, but they were not finished, at the time he left this country. He found that it readily mixed with oil; combined with other colours, it gave delicate and beautiful shades, and exposed for weeks to the direct rays of a midsummer sun, it remained unchanged. These properties induce me to recommend it as an addition to the number of pigments among which the artist can make a choice.

An economical process for preparing this salt, consists in boiling a mixture of one hundred and twenty-five parts of iodine, and two hundred and fifty parts of clean fine iron filings, with one thousand parts of rain water, in an oil flask. When the brown colour of the liquid is succeeded by a light green, the clear fluid is decanted, and the residue washed with warm water; the washings being added to the green solution, two hundred and seventy-two parts of corrosive sublimate, dissolved in two thousand parts of warm water, are then added to the former liquor, and the resulting precipitate is afterwards washed and collected.

This salt, either in crystals, or in powder, presents two distinct and beautiful colours. If the precipitate, obtained as above, be heated in a small subliming apparatus, or in a glass tube, it melts and sublimes copiously, and the vapour is condensed in large transparent rhombic tables, of a fine sulphur yellow colour. These crystals are permanent in the air, and unaltered by the direct solar rays; but the slightest friction, or the contact of a fine point, is sufficient to alter their interior arrangement. The point of contact instantly becomes of *a rich scarlet*, and the same colour spreads over the whole surface of a single crystal, and extends to the most remote angle, if a group of crystals be the subject of experiment. This change of colour is accompanied by a sensible mechanical motion, so that a small heap of the crystals appears as if animated. An ordinary electroscope does not indicate the development of any electricity, nor is there any considerable elevation of temperature, during the change.

By gently warming the crystals supported on paper over the flame of a lamp, the original yellow coloured salt is obtained, and the same experiments may be often repeated; affording an elegant illustration of the connexion between colours, and the mechanical structure of bodies. Transparent, but minute, rhombic prisms of this salt, may be obtained by allowing a hot solution of it, in a solution of corrosive sublimate, to cool very gradually. [*Ib.*

Singular Galvanic Trough.

M. Watkins, philosophical instrument maker, of London, has constructed a Voltaic pile, with a single metal and without any liquid. It consists of from 60 to 80 plates of zinc, four inches square, fixed in a wooden trough, at a short distance from each other, having only a thin plate of air between them. One side of each plate is smoothed and polished, the other left rough. The polished faces are all turned in one direction. If one extremity of the pile be made to communicate with the ground, and the other with an electroscope, the latter immediately indicates one or other of the two electricities, according to the pole with which it is in contact. The humidity of the air favours the action of the pile, which may be considered as a kind of dry pile in which air is substituted for paper, and the two surfaces of the zinc do the office of two heterogeneous metals. It

appears to be to the stronger oxidation of the polished surface that we are to ascribe the development of electricity in each plate of the zinc; the intermediate strata of air, and perhaps the trough, permitting this electricity to accumulate as in the ordinary pile.

Annales de Chimie et de Physique, Aout, 1828.

Differential Barometer. By the late Dr. Wollaston.

This instrument is capable of measuring, with considerable accuracy, extremely small difference of barometric pressure. It was originally contrived with the view of determining the force of ascent of heated air in chimneys of different kinds; but as its construction admits of any assignable degree of sensibility being given to it, it is susceptible of application to any other purpose of more extensive utility. A glass tube, of which the internal diameter is at least a quarter of an inch, being bent in the middle into the form of an inverted syphon, with the legs parallel to each other, is cemented at each of its open extremities into the bottom of a separate cistern, about two inches in diameter. One of these cisterns is closed on all sides, excepting where a small horizontal pipe opens from it laterally at its upper part; while the other cistern remains open. The lower portion of the glass tube is filled with water or other fluid, to the height of two or three inches; while the remaining parts of the tube, together with the cistern, to the depth of about half an inch, are filled with oil; care being taken to bring the surfaces of water in both legs to the same level, by equalizing the pressure of the incumbent columns of oil. If the horizontal pipe be applied to the key-hole of a door, or any similar perforation in the partition between portions of the atmosphere in which the pressures are unequal, the fluid in the corresponding half of the instrument will be depressed, while it is raised in the opposite one, until the excess of weight in the column that is elevated will just balance the external force resulting from the inequality of atmospheric pressure upon the surface of the oil in both cisterns. This, however, is equal only to the difference between the weight of the column of water pressing on one side, and that of an equal column of oil which occupies the same length of tube on the other side; this difference depending upon the relative specific gravities of the two fluids, will, in the case of olive oil and water, be about one-eleventh of the weight of the column of water elevated. But the sensibility of the instrument might be increased at pleasure, by mixing with the water a greater or less quantity of alcohol, by which the excess of its specific gravity over that of the oil may be reduced to one-twentieth, one-thirtieth, or any other assignable proportion. The instrument may be converted into an anemometer, by closing both the cisterns, and by applying to the upper part of each a trumpet-mouth aperture, opening laterally.

[*Newton's Journal.*

On a New Use of the Chromate of Potash. *By* M. Kaechlin-Schouch.

[From the *Ann. de l'Industrie.*]

This use of the chromate is to print a white pattern on a blue or green ground. A blue colour is first given to the cloth by means of the indigo vat, more or less deep, according to the green required; the cloth is then prepared with the aluminous mordant, and passed through hot water; it is then again prepared with an ungummed solution of bi-chromate of potash, consisting of 2½ ounces of salt to 4 pints of water. It is then printed with the following preparation:

Water thickened by roasted starch, -	4 pounds.
Tartaric Acid, - - - - - - -	10 ounces.
Oxalic Acid, - - - - - - -	6 ounces.
Nitric Acid, - - - - - - -	2 ounces.

The nitric acid is unnecessary, except for delicate designs. The moment this substance is printed, the blue colour is destroyed; the cloth is instantly put into running water, and afterwards dyed in quercitron, or other dye stuffs.

This destruction of vegetable colour arises from the following general fact: whenever chromate of potash is mingled with tartaric or oxalic acid, or with a neutral vegetable substance, and a mineral acid, as the sulphuric or nitric, a strong action takes place, accompanied with the disengagement of heat and gaseous substances. The principal product of this reciprocal action is a new body having acid properties. During the effervescence which takes place, the mixture has the power of destroying vegetable colours. Carbonic acid is evolved during the decomposition; and when the mixture is made in a retort, there comes over a colourless liquid, slightly acid, having the odour of weak acetic acid, and reducing the nitrates of silver or mercury if heated with them (formic acid?)

When 9 parts of tartaric acid and 10 parts of chromate of potash are boiled with water, a neutral green liquid is obtained, which being evaporated, does not crystallize, but becomes a brittle green mass. When acetate of lead is added to the solution, a precipitate is formed, which being well washed and then carefully decomposed by sulphuric acid, yields a very acid green fluid, uncrystallizable, and with alkalies forming either acid, greenish-violet salts, or neutral-green salts. Cold sulphuric or nitric acids, do not act upon this substance, but being heated, they decompose it. When the acid itself is calcined, it yields green oxide of chrome.

On the Fusion of Tallow.

[From the same.]

The Council of Health at Nantes has been engaged in an investigation of the best means of fusing tallow, so as to avoid the injury and annoyance which arises from an abundant liberation of vapours, when the ordinary method is used. Much pains has been taken in acquiring all the information possible, and numerous experiments

have been made, both on a large and small scale. The best process which the council has instituted, appears to consist in using, according to M. D'Arcet's suggestion, a certain proportion of sulphuric acid, and operating in close vessels. By the use of the acid, the fumes always evolved are very much altered and ameliorated in quality, at the same time that the fused tallow is improved in quality and increased in quantity, the fusion very much quickened, and the use of a press dispensed with. By the use of close vessels, the fumes evolved can be either conducted to a fire-place to be burnt, or, if that may be thought dangerous, in consequence of the occasional boiling over of the melted tallow, can be conducted into a condensing apparatus, which is found readily to condense them.

M. D'Arcet uses 100 parts of crude tallow in small pieces, 50 parts of water, and one part of sulphuric acid, sp. gr. 1.848. In some small experiments a digester was used, having a pierced copper plate near the bottom to avoid the necessity of stirring; 1500 (316.5 oz.) parts of crude tallow, 750 of water, and 124 of oil of vitriol, were used, and the fumes conveyed by a pipe into a fire-place; half an hour's ebullition completed the fusion. The infusible matter, when pressed into a cloth, weighed only 96 parts, and was slightly acid. The tallow was white, hard, and sonorous, and *not* acid. Without the acid the same effect was not produced in an hour.

A tallow manufacturer then tried the experiment with 2 cwt. of tallow, using the acid, but operating in open vessels; 92 per cent. of fused tallow was obtained, and 8 of loss occurred. In a second large experiment with acid, only 5 of loss occurred. The residue does not require the use of a press, but cannot be made into cakes for cattle unless previously freed from acid by washing.

Experiments made on the condensation of the vapour were found to succeed very well, and thus all fear of injury from fire is avoided. The council propose conducting the vapours into the drains of the works, and so condensing them there; no annoyance being apprehended from the occasional return of the vapours into the building, as that effect can be counteracted by the use of stink traps.

Construction of Magnetic Needles.

According to M. de Legey, steel for magnetic needles should not be selected from amongst springs, for such steel is formed of fibres more or less hard, which, by the action of the hammer, has had different directions and unequal hardness given to them. M. Legey prefers German laminated steel plate, from which he cuts a strip in the direction of the length, and then draws it out so as to close the pores, till it is very brittle. From this plate he cuts the lozenge intended for the needle. All the operations should tend to lengthen the fibres in parallel directions. The steel is then to be hardened, after which it is to be moderately tempered, then polished on the wheel, and finally magnetized.

Before magnetizing the needle, it is examined, and usually found to have two poles. Whatever may have caused them, M. Legey regards the needle as more apt to receive magnetism, according to the position of these poles, than in any other direction, and, therefore, endeavours to preserve them in every operation to which the needle is subjected; thus, in the polishing, it should always be done in the direction of the length of the needles, and the southern poles should be held opposite to the course of the wheel; a proceeding which it is affirmed preserves the position of the poles. When the needle is magnetized, the same attention to its previous state is to be given. [*Bulletin de la Societé d'Encouragement.*

New Razor Strops.

A new kind of razor strop, invented by M. Ferrot, has received the name of *outhegone*. From the flexibility of leather, a round edge is given to the blade, for which reason paper is used in the new strop. Two kinds of very fine paper have been manufactured purposely, with fine and homogeneous pulp, mixed in the one case with fine emery, and in the other with very fine rouge. These papers are then steeped in melted tallow, afterwards pressed to give them a smooth surface, and then cut into bands, and mounted on pieces of wood properly shaped. Each strop has, therefore, two faces, one gray, on which the razor may be rendered very sharp, and the other red, which, polishing the edge, renders it extremely smooth. The razor must be laid very flat upon these strops—they improve by a few days' use. When ineffectual from age, the surface should be rubbed with a very smooth piece of pumice, or with a little pumice powder on marble or ground glass: being then wiped with a piece of cloth, they are brought to their first state. [*Ib.*

Use of Chameleon Mineral for Marking Linen.

In many large establishments, linen requires to be marked quickly, permanently, and economically. The following is a process recommended in France: prepare a chameleon mineral, by heating a mixture of one part of oxide of manganese of commerce, and two parts of nitre, or common potash, to redness; the green substance obtained is to be preserved in dry bottles, as it changes in the air. When required for use, it is to be powdered, and mixed with its weight of pipe clay, and then water added, to make a very thin paste. It is this mixture which is to be applied to the linen, either by a brush, or a stamp, or in the manner of stencilling, or even by a pen, if it be made thin and used quickly. The green paste quickly changes to brown on the linen, and the latter being washed about half an hour afterwards, the loose particles and the potash are removed, and the marks left of a deep brown colour. This writing perfectly resists the action of alkaline lixivia, even though strong; it also resists soap and weak acids: hence the progress may be useful to calico

printers. The operation depends upon the reduction of the manganesic acid in the chameleon mineral to the state of oxide by any organized matter. The same circumstance renders it necessary to keep the substance from the contact of such bodies, and it is in its best state when recently prepared. [*Quart. Journ.*

Separation of Silver and Copper.

The amalgam obtained at the silver works at Freyberg, leaves, when decomposed by heat, an alloy of silver, copper, and other metals; the latter used to be separated from silver by boiling, and dissolving the whole in strong sulphuric acid, and then precipitating the silver. Of late, a process altogether new has been introduced. The alloy is now heated in a reverbatory furnace, exposed to air, so as to oxidize the copper, and is afterwards put into the caldrons of lead, and heated with dilute sulphuric acid, which dissolves the oxide of copper previously formed; the operations of roasting and digesting, are repeated once or twice, and many precautions are requisite to obtain a good result, but these being attended to, the process is much more economical than the ancient one. The silver is not so pure, retaining about $\frac{1}{25}$ of copper; but this is of no consequence for ordinary uses. [*Ann. des Mines*, iii. 15.

On Mr. Leigh Phillips's *mode of Heating Warehouses, &c.; and his Balista Door Spring. By* Thomas Gill, Esq. *Editor of the Technological Repository.*

It is now upwards of twenty years since the editor first saw the simple and effectual mode of applying heat used by Mr. Phillips, in warming the four stories of a cotton factory, or warehouse, belonging to his firm, in Manchester.

A *cockle*, or cast-iron oven-shaped stove, or fire-place, was erected on the ground floor of the warehouse, and heated red hot, in the usual manner; but instead of suffering the heat to escape up the chimney at once, the upper end of the flue, near the roof, was arched and turned downwards again, parallel to the first flue; and this second flue was again curved or arched at the bottom, and again carried up perpendicularly, by the side of the two others, and thus forming three flues side by side, and constituting a mass of brickwork, which, when once heated, continued to give out its heat for a considerable length of time. The last flue finally passed through the roof, and finished in a chimney; it being also furnished with a sliding register plate, near to the roof of the uppermost story of the building, in order to regulate the draught of the furnace. Mr. Phillips was highly gratified with the performance of his stove; and, indeed, we think it well deserves to be imitated by all persons who have occasion to heat similar premises.

Mr. Leigh Phillips's Balista door spring.—He took the precaution

of causing all the doors of his premises to shut of their own accord, in order to hinder the cold air from entering, and thus counteracting the effect of his heating apparatus, by applying to each door a very simple spring of his contrivance, and which he termed his *balista spring*, from its being formed in a manner somewhat similar to the ancient Roman warlike machine of that name.

This spring consisted of a piece of rope tied together at its ends, and forming a coil, which was secured above and below by being passed through two staples driven into the door frame, behind the door; the four parts of the rope received within them, at their middle part, a square piece of wood, two inches thick and four inches long, tapered away towards its ends, and having four grooves made along its edges at each end of it, for the ropes to lodge in. A mortise hole was also made through the middle of the block, in which one end of a flat bar of wood could be placed, after the ropes had been twisted together, by turning the block round within them; and the other, or longer end of the wooden bar, then acted against the door by the untwisting of the ropes, so as to close it exactly in a similar manner to the usual door springs. These cheap substitutes for the ordinary door springs, had long continued in use, and most completely answered their purpose. [*Tech. Rep.*

Notice of a Calico Printer's Drying Stove, at Manchester. By the same.

The editor has examined the above mentioned stove. It was heated by means of a red hot cast-iron cockle, placed in the middle of its ground floor; but its other floors consisted of flat *reticulated* arches of brick-work, through the apertures in which the heat circulated through the whole building. He was almost afraid at first sight, to step upon this seemingly insecure species of floor, but was afterwards convinced that his fears were without any proper foundation, and that the floors were abundantly strong for their required purpose. The rows of arches abutted against upright plates of cast-iron, with projecting ledges underneath them, on each side, upon which the bricks were also lodged; and these iron plates were supported upon cast-iron pillars, the whole being thus also rendered completely fire proof. The interstices were formed by the bricks not touching each other *endways*, although they had a sufficient bearing against each other *sideways*, to insure their firmness and stability. It must have been a bold undertaking on the part of the architect who first constructed such a floor! [*Ib.*

On a Cheap and Simple Crane. By the same.

In a cotton warehouse several stories high, at Manchester, Mr. Gill examined a cheap and simple crane, the construction of which he thus describes. It consisted of what is termed a rag-wheel, or

a wooden wheel of six feet in diameter, around the rim of which were driven, at equal distances, a number of pieces of iron, made in the form of the letter Y, and around and between the forks of which pieces of iron, an endless rope or cable was passed, that descended from the uppermost room, where the crane was fixed, through all the other rooms to the ground floor, so as to be accessible in them all, and thus to raise or lower any goods, by means of a rope or chain, which was wound upon a smaller barrel, affixed upon the same axis with the great wheel, and to which rope or chain the goods were hung. Considerable use is also made of a similar rag-wheel, in raising or lowering the various machines employed in the scenery, &c. of theatres; and it is highly deserving of being employed in many other cases. [*Ib.*

Manufacture of Scotch Whiskey.

It is a remarkable fact, says major-general Stewart, in an article on the prevention of smuggling in the Highlands, inserted in the Quarterly Journal of Agriculture, that a spirit of the best quality and flavour has been distilled by men with their apparatus at the side of a burn, and, perhaps, changing weekly from fear of a discovery; malting on the open heath far up the hills, and hurrying on the whole process to avoid detection; yet, with all these disadvantages, they received the highest price in the market for the spirit thus manufactured. The quantity might, perhaps, be less than what could be produced by a more regular process of distillation; but then the liquor was so much superior in flavour and quality, as to compensate for the deficient quantity. Several of these men have been employed, by way of experiment, in a licensed distillery on the estate of Garth, with directions to proceed in their own way, only to be regulated by the laws under the control of an officer; yet, with the advantage of the best utensils, the purest water, and the best fuel, they produced a spirit quite inferior in quality and flavour to what they made under the shelter of a rock, or in a den, and it sustained neither the same price nor character in the market.

[*Quart. Journ. Agri.*

Preservation of Grain in Reservoirs of Clay.

A German, M. Fischer, in the *Archiv fur die gesamte Naturlehre*, tom. iv. No. 1, communicates the following plan, pursued by him in preserving grain. He erected with unburnt bricks, a square building, 28 feet on each side, and 35 feet high; the walls 3 feet thick, and the bricks well conjoined by means of clay. The floor, also, was formed of worked clay, and raised a foot above the level of the surrounding ground. This tub, as it were, being covered with a simple roofing, and thatched, and the brick-work completely dry, 1100 sacks

of dry wheat were poured into it: the wheat was covered with straw, and over this straw was placed a layer of dry clay, a foot thick, thoroughly trodden and beaten down. Several years afterwards, on the opening of this magazine, the wheat was found dry, and perfectly good; and, what is more, is said to have possessed, for the purposes of making bread and pastry, qualities, far superior to those of wheat preserved in magazines admitting air. [*London Mag.*

FOR THE JOURNAL OF THE FRANKLIN INSTITUTE.

On Colza Oil.

Extract of a letter from Thomas G. Clemson, Paris, to Jacob Green, M. D. Professor of Chemistry in Jefferson Medical College, Philadelphia.

Paris, September 18, 1828.

Dear Sir,—In accordance with the wish which you expressed when you were in Paris, I send you the following remarks respecting the *oil* that is burnt throughout France.

It is known by the name of Colza Oil, *Huile de Colza*, and is extracted from the grain of the Brassica Arvensis, or Campestris, a species of cabbage.

The Colza is very much cultivated throughout France and the Netherlands, on account of its various and useful qualities. In the north of France, and particularly in the environs of Lille, the greatest possible attention is paid by the inhabitants to its production. The seed is sown during the month of July, as we sow our seed for the purpose of procuring cabbage plants. The shoots are transplanted in the month of September; a cloudy day being preferred. A man goes ahead, making holes in the earth, at a distance of about twelve inches from each other; he is immediately followed by a child, who puts into each hole a single plant; a third person finishes the operation by closing the earth around the plant by means of a hoe. When the seed becomes ripe, which generally happens in the month of July of the following year, the plant is cut, tied in small bundles, and put under a shed, or any covered and airy place, to dry. The grain is beaten out, and cleaned in the manner commonly used for the extraction of wheat or other grain, and is then treated for the oil. As the oil comes from the press it may be directly used, with potash, for the fabrication of soft soap; but if intended for burning, it is necessary that it should undergo another preparation, in order to separate from it its mucilage and the colouring matter which prevents its ready combustion. We are indebted to M. Thenard for the method of purification. It consists in mixing two parts of sulphuric acid (concentrated,) with a hundred parts of *oil*, which are to be well stirred together until the acid combines with the mucilage and colouring matter, which are gradually precipitated in flakes of a blackish green colour, after which a quantity of water equal to double that of the oil is added; the whole is then freely agitated with the inten-

tion of depriving the oil of the free acid; it is then left to settle for the space of ten days, at the end of which time the oil which is upon the surface of the water is decanted into tubs, in the bottom of which are holes filled with cotton, through which the oil is allowed to filtre, when it is perfectly pure. This method of purification is applicable to all seed oils. The oil of Colza thus prepared, has very little odour, is of a yellow colour, and has a sweetish taste. It is not very soluble in alcohol. When congealed it crystallizes in small needles diverging from a centre.

Yours, &c.

THOMAS G. CLEMSON.

LIST OF ENGLISH PATENTS

Which passed the great seal, from January 27, to March 19, 1829.

To John Hopper Carrey, Goldsmith and Jeweller, for certain improvements in the construction of umbrellas and parasols—Jan. 27.

To James Fraser, Engineer, for a new and improved arrangement of a flue, or flues, to communicate with the various parts of culinary apparatus; such as steam, soup, or water boilers, oven or ovens, hot plate or plates, hot closet or closets, and stewing stove or stoves, to render them more compact; and also to appropriate part of the said apparatus to effect other useful purposes—January 27.

To John Braithwaite and John Ericsson, Engineers, for a mode or method of converting liquids into vapour or steam—January 31.

To Robert Parker, a lieutenant in the Royal Navy, for an improved drag, or apparatus, which is applicable to stage coaches, and other wheel carriages; and whereby the motion thereof may be retarded, or stopped, when required—January 31.

To Joseph Rayner, Civil Engineer, for certain improvements in apparatus and machinery, for conducting heat and applying the same in the operations of washing, scouring, cleansing, fulling, dressing, dying, and finishing woollen cloths; and in callendering, straining, glossing, polishing, and finishing, silks, cottons, linens, woollens, and all other goods, to which the same may be applicable—February 5.

To Julius Pumphrey, Glover, for certain improvements in steam engines, and machinery connected therewith, to propel steam boats, and vessels; some parts of which improvements are also applicable to other purposes—February 5.

To John Burgis, Ornamental Paper Manufacturer, for a method or methods of gilding or silvering certain woven fabrics, in burnished, or burnished and dead, or matted gold and silver; and which said fabrics may be used as gold or silver, and lace borderings, and for other purposes—February 5.

To Alexander Daninos, for a certain invention for the manufacture of improved hats and bonnets, in imitation of Leghorn straw hats and bonnets, which invention was communicated to him by a foreigner residing abroad—February 5.

To Richard Green, Ship Builder, for certain improvements in the construction of made masts—February 5.

To William Henry Kitchen, Ironmonger, and Andrew Smith, Merchant, for certain improvements in the construction of window frames, sashes, or casements, shutters, and doors, designed to afford security against burglars, as well as to exclude the weather—February 7.

To Edward Heard, Chemist, for a certain improvement, or improvements, in illumination, or producing artificial light—Feb. 12.

To Samuel Walker, Cloth Manufacturer, for an improved apparatus, which he denominates "an Operameter," applicable to machinery for dressing woollen or other cloths—February 20.

To George Hayden, Engineer, for certain improvements in machinery for dressing cloths—March 2.

To William Storey, Plumber and Glazier, and Samuel Hirst, Clothier, for certain materials, which, when combined, are suited to be employed in scouring, milling, or fulling, cleansing and washing, of cloths and other fabrics; and by the employment of which materials, considerable improvements in those processes are effected—March 10.

To Richard Hall, Tailor and Woollen Draper, for a composition applicable to certain fabrics, or substances, from which may be manufactured boots, shoes, and various other articles—March 10.

To James Willis Wayte, Printer, for certain improvements in printing machinery—March 19.

LIST OF FRENCH PATENTS

Granted in the second quarter of 1828.

[Concluded from page 368, vol. III.]

To Thomas Preston, of Dichy, for improvements in manufacturing rolled, or sheet lead—10 years.

To Auguste Noverre, of Paris, for a machine to manufacture dough for bread and biscuits—10 years.

To Antoine Perpigna, of Paris, for a new evaporating apparatus—10 years.

To François Rever, of Conteville, for a gas bottle emptier—5 years.

To Theodore Parquin, of Paris, for a process for manufacturing coffee pots of tinned copper, called "Levant Coffee Pots"—5 years.

To Labarthe, of Paris, for a new lamp nozle—5 years.

To Liebaut, of Paris, for apparatus for bleaching sugar and sirops—5 years.

To Jean Joseph Giraud, of Bagnols, for a machine to wind silk from the cocoons—5 years.

To Auguste Moineau, of Paris, for a continuous moving power, applicable to machines, as to time pieces—15 years.

To Morel, Garnier, and Suireau, of Paris, for a new arrangement in hydrostatic lamps—5 years.

To Antoine Gaily Garalat, of Versailles, for an aerostatic lamp—10 years.

To Feliz Haize, of Paris, for manufacturing horse shoes by a stamping machine—10 years.

To Jean Clavé, of Haute Marne, for double bellows with a flexible division—5 years.

To Victor Odent, of Courtalin, for a machine to manufacture paper with economy and ease—5 years.

To Jean Queyras, of Camoret, a furnace, or heater, for two vessels, for unwinding cocoons—5 years.

To John Nicholson, of Paris, for a paper ruling machine—10 years.

To Jacques Debenzis, of Paris, for elastic stuffing to sophas—10 years.

To Thomas Hall, of Amiens, for embossing stuffs of cotton, wool, or silk, intended for furniture—5 years.

To Bruneaux and Denormand, of Retel, for moveable wool combs operating by an eccentric—5 years.

To Cesbron, of Paris, for a hand mill for grinding grain—10 years.

To Chateaneuf and Grandboulogne, of St. Jean de Royans, for fulling apparatus for manufacturing hats—5 years.

To Etienne Leblanc, of Paris, for buttons, called "Diana Buttons"—5 years.

To Roux, of Paris, for a pressure safety lock---5 years.

To Louis Halette, of Arras, for apparatus for the manufacture of sugar from beet-root—10 years.

To Prosper Meynier, of Lyons, for machinery to weave several damask ribands at one operation—10 years.

To Pierre Dumontier, of Pantin, for a method of using pit coal in preparing plaster of Paris—5 years.

To Lemoine, of Paris, for improvements in 'Pauly's guns'—5 years.

To Naudot & Co., of Paris, for a machine for manufacturing bricks, tiles, &c.—15 years.

To Louis Darche, of Paris, for an economical apparatus for heating and cooking—15 years.

To Louis Ledru, of Clermont, for the application of *domite* in the arts—10 years.

To Jean Moulliere, of Surgeres, for a furnace for the distillation of brandy—5 years.

To Lemoine, of Paris, for wind cushions—5 years.

To Cyprian Prosper Brard, of Frejus, for making paper from wood—5 years.

To Bunten, of Paris, for a barometer, in which the tube and cistern are of a new construction—5 years.

To Bricaille, of Paris, for a moveable spelling table, to teach reading in a short time—5 years.

To Witz, of Cernay, for a new process for spinning cotton and other fibrous materials.

To Petit Pierre, of Paris, for a new method of casting music—5 years.

To Julian Dumont, of Paris, for improvements in his sugar-clarifying apparatus—10 years.

To Bernard Bonnet, of Nantes, for machinery to manufacture iron thimbles employed in the rigging of vessels—10 years.

To George De Bovier, of Paris, for a method of varnishing or japanning, in a variety of colours, clasps, pins, &c. for head dresses, and other small metallic articles—5 years.

To Gaspard Christian, of Paris, for a new system of operations in the spinning and preparing silk for various purposes—15 years.

To Charles Derosne, of Paris, for processes in cleaning and bleaching of vegetable saccharine juices, and in various operations in the refining of raw sugars—15 years.

To Aimé Bourbon, of Paris, for hydraulic machines for ascending rivers, and draining marshes—15 years.

To Jean Escofier, of Bordeau, for an hydraulic machine, with a fixed inclined plane and axis, worked by horse power—5 years.

To John Nicholson, of Paris, for a machine for shearing cloth—5 years.

To Madame Fournier, of Paris, for improvements in parts of the dresses in males and females, and particularly in corsets for the cure of defects in the shape—5 years.

To Jean Foucault, of Paris, for newly invented iron wheels, with double spokes, for carriages, and particularly for artillery—5 years.

NOTICES.

The communication on *Inertia*, is in the hands of the printer, and will appear in the next number.

The cuts required to accompany the solution of questions discussed at the monthly meeting of the Franklin Institute, are in preparation, and will be ready for the next number; when the communications of Mr. Charles Potts, and of Mr. D. U. Mason, will appear.

The article relating to "Walker's Refrigerators," which are represented in the plate, has been crowded out, but will be inserted in the December number.

Persons who write to the Editor, on the subject of the Journal, are requested always to *pay the postage;* the *profits* will not enable him to do so.

Individuals living in remote places, where there are no agents to guarantee the payment, are expected to remit the money when they order the Journal. Those who are fearful of trusting the Institute, must expect a reciprocity of feeling.